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In the Supreme Court of the United States.

The Carnegie Steel Company,
Limited,
Appellant,

against

Cambria Iron Company,
Respondent.

On writ of certiorari to the United States Circuit Court of Appeals for the Third Circuit.

Brief for Complainant.

The estimate which the parties concerned have of the importance of this case is manifested physically by the size of the record and by its contents. Nearly thirty patents have been exhibited, many photographs and working drawings, nearly sixteen hundred pages of printed matter, including three and thirty articles from various journals, displaying altogether about three-quarters of a million words—and yet, as very often happens in such cases, the matter has finally come down to a limit which renders discussion possible.

One could hardly hope to rival in logical order or in carefulness of selection the opinion of the District Court, which presents a thoroughly well reasoned resumé of all the testimony which is really of importance in the case. The testimony and the discussion have both taken a very wide range, because endeavors have been made to show resemblances between the process which has been patented, and which is novel, and other processes which are neither new nor unusual, and which keep date really with the foundation of the world. I suppose there has been no time when the art of mixing, for the purpose of imparting to each of the component parts a portion at least of the peculiarities of the other parts, has not been practiced in all departments of life. Mixing for that purpose has had a range as wide as the breakfast table, and the final processes of civilization by the mingling of races to form the nations which now exist. If the patent under discussion was an attempt to claim the process of mixing, for the purpose of unifying the quality of the resulting mixture, there has been no time that we know of when it would have met with success. Such, however, is not the object of the process, nor does it work itself out in that naked and well-known manner.

The Whitney mixing has been cited as an example of those things which resemble the patent under consideration. By that system, iron was melted in cupolas, and run from them into a common reservoir, where a uniformity was produced which was absolutely necessary and which was calculated upon from the beginning. The purpose for which they wished to use the iron, the casting of car wheels, was such that it became necessary to have a uniform compound containing all the qualities which should go into iron intended for the special purpose for which the car wheels were cast. Therefore, they selected the iron for each cupola and then blended the whole in a common reservoir.

Pursuant to this method of examination, the respondents have even brought in the casting of the great Rodman gun which was the wonder of its time, and find that that also anticipated the Jones process. It seems difficult to human imagination to be misled to that extent. Nevertheless, it was the fact that one furnace not being sufficient for the casting of the gun, and as the gun had to be more or less uniform in its texture, metal was taken from two or more furnaces and poured into a reservoir, and from that reservoir was poured into the gun mould. Surely it needs no argument to make it clear that that process, which was simply intended to make a composite metal fit for work that must be homogeneous, and to be sure of enough metal for a full casting, was not a process by which metal was prepared for continuous use in the converter.

The same is the fact with regard to the Altoona factory and its processes. These same processes people had in mind with regard to the Bessemer steel production ever since that invention, but they never could reach the practical process for which Captain Jones obtained the patent which is in dispute here. It had long been a desideratum in the art to manufacture steel directly, or almost directly, from the blast furnaces. The advantages of it were so obvious that even the extensive literature which is presented to the Court has been absolutely saturated with the expression of the desire to arrive at some method of accomplishing what Sir Henry Bessemer had in his mind when he invented the process. He had no idea of making his steel in any other way when the invention had been finally perfected. Circumstances were such that he was unable, at the time when he made his first steel, to command even the appliances which he might at that time have thought necessary, and the difficulties in subsequent experiments with regard to that subject matter presented themselves in such a way that they were not covered by human ingenuity until the patent in question was issued.

There is no question whatever that not only Sir Henry Bessemer, but all his successors, had in their minds that direct (or almost direct) flowing of molten metal from the blast furnace to the converter should take place. Nevertheless, as an actual practice it never happened in any form, except under the peculiar circumstances arising from the treatment of peculiar ores such as took place in Germany and at Terre Noire, and by process differing from ours. During all the time, up to the invention in question, another process had been used, and for a very simple reason. The Bessemer invention was founded on the idea that the iron contained its own means of purification, and by the application of air blown through the carbon already existing in the iron could be burned out, together with the silicon and other impurities, and then a sufficient amount of carbon could be replaced by means of spiegeleisen, so that steel suitable for ordinary commercial purposes could be produced in large quantities. Before that time steel had been produced in small quantities in the crucibles, but the crucible could not furnish enough for the purposes to which Bessemer steel was afterwards put. Upon the success of the Bessemer steel process rested, among other things, the railroad prosperity of this and other countries. The reason why the Bessemer steel could not be made by pouring the products of the blast furnace directly into the converter arose from the very great difference in the character of the iron, which came out of different blast furnaces and out of the same blast furnace at different times, or even at different stages of its operation. The main source of heat in the converter arose from the combustion of silicon. If there was a suitable amount of silicon in the iron which was poured into the converter the iron was purified without too much waste and was cast into ingots which could be used for the manufacture of the best kind of steel rails. If the quantity of silicon was too small the purification failed ; if too great there was a large loss of the steel product.

The treatment of the iron in the converter differed according as the silicon was in large or small percentage, and as the iron from the blast furnaces varied very much it was necessary to change the treatment so as to meet that variance. This required a great deal of skill, as a matter of actual practice, and even the greatest skill could not overcome the disadvantage of too great variations in the successive charges of the converter. There seemed to be no way of regulating the outpour from the blast furnaces so as to make practicable the purification of the iron in such quantities as to save loss from inferior iron made by error arising from the sudden changes of the character of the contents of the successive charges of the converter. Of course, if one could have had the iron directly from the blast furnaces the heat might be retained, thus saving the necessity of the application of any more heat. If, however, you had to cast the product of the blast furnace into pigs you had to lose the heat, and so great were the temperatures that it was a very serious loss. Nevertheless, up to the time of the Jones invention, that loss had to be borne, in consideration of the following advantages: If pig iron was carefully selected and melted in cupolas, and the iron taken in ladles from the cupolas to the converter, it was found that more uniform iron could be made—iron more suitable to be treated by the Bessemer process, and consequently, losses were avoided which arose from imperfect rails, the result of bad steel. The cost and expense of remelting and mixing deepened the desire of all practical men for many years to discover some method whereby the heat in the molten metal directly from the blast could be saved as well as the cost of the remelting of the iron and the expense of breaking it up and treating it in the cupolas; but while everybody recognized the necessity of this, nobody seemed to see his way to the actual practical method of accomplishing the object sought for.

Perhaps no more striking discussion can be found with regard to the condition of things than in the report of Mr. Holly, of June, 1887. Mr. Holly was the consulting engineer of all the great steel works in this country. He was deservedly held in the highest esteem, and he made it his business to go wherever steel works were, in order to ascertain for his American clients, in whose employ he was, all the latest and best processes which up to that time had been introduced into the practice of European works. In that report which deserves most careful reading, is to be found one or two facts and conclusions which have great bearing upon the present controversy.

All the conclusions which can be found in page 845 of the record deserve a most attentive reading, because they contain a résumé of the condition of the art at the time when the report was made ; and, while it is claimed by the respondents in this case that they can find therein the practice which is the subject of Mr. Jones' patent, it is perfectly evident to a careful reader that Mr. Holly himself had never discovered it, nor, indeed, did he have anything which looks like an anticipation of the invention of Captain Jones, for his " conclusion " is that, " while we congratulate ourselves that the direct-metal users have no large advantages over us in the present state of the art, we may look forward to the metal-storing problem with good hope, not only of more economical manufacture, but of a more uniform product " (p. 846). " In fact," he says (p. 845), " this mixing of irregular irons on a very large scale, thus avoiding the expensive niceties of ore selection and the necessity of many furnaces, is the *theoretical* key to the situation." Thus, he recognized that no *practical* key had yet been discovered. Indeed, he had already said (p. 837) : " Ores will never be uniform ; hence, uniform results in the Bessemer Department can hardly be expected unless a number of blast-furnace charges are mixed. This would seem to be the *theoretical* solution of the problem." Again the word " *theoretical*," which clearly shows the absence of *practical* solution. He goes on to say (p. 845) :

> "When the way to its successful adoption is demonstrated, the direct process will undoubtedly have great advantages, even over the present practice on the continent, which employs manganiferous ores. But until this *large-scale mixing is developed,* it should not appear that the use of our comparatively irregular blast-furnace metal, and more especially the use of part blast-furnace and part cupola metal, can result in any substantial saving."

This seems to me to be a statement of the case which is an exact exposition of the state of the art at the time he wrote, and what he says is thoroughly supported by the large mass of testimony as to what has been said at the various meetings held in England and elsewhere of persons interested in steel works and the manufacture of steel. The idea of mixing so as to produce a uniform metal as the basis for further operations by means of the Bessemer converter was not only obvious, but was in everybody's mind as a possible solution of the difficulty; but the difficulties in the way were so great that Mr. Holly thought nobody had any advantage in using that system over the cupola system which then prevailed, and in regard to which he did not feel it necessary to urge upon his clients any change. Knowing, as everybody did, that metals of different grades and kinds could be so mingled as to produce a uniform result so far as the particular mixture was concerned, no one ever thought of what is the essence of the Jones invention, and that was a continuous mixing governed by a dominating pool. All the experiments which had been tried had for their idea the mixing of a single mixture, a batch as it were, the using of that mixture until it was exhausted, the making of another one and then using that; but a continuous process of mixing, which was the real solution of the difficulty, never entered into men's minds. Indeed, it is a most remarkable thing, as showing how people's minds were penetrated with the idea that the solution of the difficulty was simply a mixture ; that when Captain Jones gave orders for the first practical working of the process under his patent, in the mixer he had erected, as will be found in the testimony of Mr. Gayley (p. 544), the workmen, including Gayley himself, an expert on the subject, simply proposed to fill up Captain Jones' mixer and then empty it. But before they had succeeded in doing that the attention of the inventor was called to it, and he gave direct orders that the pouring into the mixer should continue as well as the pouring out. This circumstance alone is strong evidence that the expert mind had not got beyond mere "mixing," while Captain Jones had clear ideas of "continuous mixing." The whole secret of his invention, as Mr. Carnegie says, with that great common-sense understanding of things which has made him so phenomenally successful, was the doctrine of averages. It was found that the operator who had charge of the converting instrument could, within a certain range, adapt himself very easily to slight changes in the constituent parts of the metal which he was working ; that it was not absolutely essential that he should have exactly the same kind of substance to operate with. It was only necesary that he should have a substance which did not differ too much from the preceding charge. Now, when a reservoir was used and the products of the blast furnace were mixed, you would have naturally a homogeneous, a like substance throughout, subject to the same treatment, and if you waited until it was all poured out you would have the same thing at last that you had at first. But the mixing each time so as to produce a homogeneous uniform mass, as a practical matter, had never been adopted by anybody ; but, if it had been, that would not have been in conflict with the process which is the subject of the invention under discussion. Captain Jones believed that it was possible for him to make a continuously flowing mixture, which would not differ one charge from its successor, to such a degree as to prevent the man in charge of the converter doing his work successfully; and the substitution of an intermittingly flowing river for a pond was the difference between successful and unsuccessful practice. The difference between the source and the mouth might be great, but the successive flowings from the mouth into the converter had so little difference that it left each charge under perfect practical control.

One of the most noticeable things in the testimony of Mr. Joseph Morgan, Jr., who was the chief engineer or superintendent of the respondents' works, is the careful way in which he derived Captain Jones' patent from both patents and literature which preceded it, by simply leaving out the continuous nature of the process, by insisting on seeing in the patent under discussion and the practice under it only a mixing of metals. It was more than a mixing of metals. It was a continuous mixture which involved the doctrine of averages, and as a practical matter it turned out that, if the following charge only differed slightly from the preceding charge, the man operating the converter could do his work, and do it accurately.

The law which seems to be applicable to such a case is found stated in Tilghman vs. Proctor (102 U. S., 707), as follows:

> " It seems to us that this clear and exact summary of the law affords the key to almost every case that can arise. 'Whoever discovers that a certain useful result will be produced in any art by the use of certain means is entitled to a patent for it, provided he specifies the means.' But everything turns on the force and meaning of the word 'means.' It is very certain that the means need not be a machine, or an apparatus; it may, as the Court says, be a *process.* A machine is a thing. A process is an act, or a mode of acting.

> The one is visible to the eye—an object of perpetual observation. The other is a conception of the mind, seen only by its effects when being executed or performed. Either may be the means of producing a useful result. The mixing of certain substances together, or the heating of a substance to a certain temperature, is a process. If the mode of doing it or the apparatus in or by which it may be done is sufficiently obvious to suggest itself, to a person skilled in the particular art it is enough, in the patent, to point out the process to be performed without giving supererogatory directions as to the apparatus or method to be employed. If the mode of applying the process is not obvious, then a description of a particular mode by which it may be applied is sufficient. There is, then, a description of the process and of one practical mode in which it may be applied. Perhaps the process is susceptible of being applied in many modes and by the use of many forms of apparatus. The inventor is not bound to describe them all in order to secure to himself the exclusive right to the process, if he is really the inventor or discoverer. But he must describe some particular mode, or some apparatus, by which the process can be applied with at least some beneficial result, in order to show that it is capable of being exhibited and performed in actual experience.

That is precisely what Captain Jones did in his patent. He described the process by which this transformation took place, and also invented the machine in which it could be done. But he made the latter the subject of a separate patent. Now, the point of objection made by the other side as to the practical working is two-fold: First, it is said that the process is simply one of mixing; that there is nothing else to do, and that it has been anticipated by various patents and by the ordinary practice with the ladle. Perhaps the defense with regard to the ladle has been given something of undue importance, owing to that portion of the patent which the complainant has disclaimed. Certainly in a careful consideration of the case as depending upon that portion of the patent which has been reserved by the patentee and his assignee, one would hardly think that the ladle played any part. In order that we may make this clear, we take the definition made by Mr. William F. Durfee, a witness on the part of the defendant (p. 211), as follows:

> " The charging ladle is a vessel, open at the top, made of boiler iron, lined with refractory material and is used to receive the metal which is charged from this charging ladle into a converter. The ladle is supposed to be sufficient in size to hold an entire charge of metal for the converter, in connection with which it is used."

And again, on page 259, in answer to Re-direct Question 119, Mr. Durfee says:

> " Casting ladles are usually made larger than is necessary to hold the exact weight of the metal contained in the converter. In pouring the metal from the converter into the casting ladle, there is always more or less cinder runs out into the ladle and floats upon the surface of the metal. It is customary to make the ladle large enough to accomodate easily both metal and cinder."

The definition above stated, standing alone by itself, shows very conclusively that the ladle was not in any sense of the word a mixing implement. It was simply a vehicle for transferring from the cupolas to the converter the charge of metal. But it ought to be added that the charging ladle got in time to be made to hold more than the charge, because it was very inconvenient if, by reason of any diminution by the cooling of the iron there was not enough liquid left to fill the converter with its proper charge. Hence, the ladle gradually got to be made holding a considerable percentage more than the converter charge. Therefore, when the ladle was again supplied, there was a certain mixing which arose from the pouring in of the new metal and its meeting the old that was left over ; but while this incidentally happened, it is evident from one set of figures to be found in the record that this incidental mixing was never considered of any grave importance. In the testimony of Mr. Price on page 327, it will be found that at the respondent's works the ladle from 1871 to 1879 contained 21,000 pounds, while the converter required a charge of 12,500 pounds, making an overplus of seventy-six per cent. From 1879 to 1888, the ladle could carry 28,000 pounds, and the converter had been raised to 15,500, which was eighty per cent. surplus. From 1889 to 1895 the ladle contained 32,000 pounds, while the converter's charge was 26,000 pounds, or an overplus of 23 per cent. only. This decrease of percentage shows very clearly that mixing had no part on the design of the process, or it had been found of so little value that whatever was in that idea was not regarded of practical importance.

I think, therefore, under these circumstances, especially since the declaimer, the mixing in the ladle can hardly be regarded as an anticipation of the patent under discussion.

In addition to the processes which I have already described, there are a number of patents which provide as a reservoir an intermediate vessel which they describe as a reverbratory furnace. I think, without exception, that in all of the patents which are referred to as anticipatory where the language in the claims is such as might seem to cover the patent under discussion, it will be found that the reverbratory intermediary is used as a reservoir for the treatment of the metal on its way to the converter. The Jones Patent alone makes the treatment consist in the uniforming of the products of various blast furnaces in such a way that without the addition of refining metal in the mixer, the converter charge is rendered so near its predecessor that it can be handled in the converter itself without extraordinary skill. It is hardly worth while to follow these various inventions and these various descriptions and patents; for a careful examination of them all will, I think, justify what I have said. It may be desirable, however, that one or two of those which are relied upon by the Circuit Court of Appeals in reversing the decision of the Circuit Court should be examined. There are the two patents of Mr. Witherow. The first is of April 14, 1885, and can be found on page 941 of the Record. It ought to be said in regard to all these inventions, that the language of the claim in addition to being read in the light of the explanation which precedes it, must also be read in the light of the knowledge or ignorance of the times in which they speak. It is undoubtedly the case that one or two of the claims seem in language to cover something like the Jones process, but a careful examination will show that they do not even begin to include that process, which was not in the mind of the inventor or in his description.

In this first patent of Witherow (on page 943) the claim is the "combination of a blast furnace, a blast-heating stove, a converting vessel, an *intermediate distributing receptacle*, and connections for the blast and transfer of the metals, substantially as and for the purposes described."

Now, he himself, on the preceding page, says:

> "Thus the vessel E constitutes an intermediate distributing reservoir for the metal after its withdrawal from the blast-furnace, the use of which obviates the necessity of interfering with the regular and uniform operation of the blast-furnace by the frequent tapping off of the relatively small

> quantity of metal necessary to charge the converter or converters, the time required for the operation in the latter being so short that they need to be charged several times between each regular tapping of the blast-furnace."

It will thus be seen there was nothing here except a reservoir for the purpose of holding the metal and enabling the workman to completely discharge the blast furnace instead of tapping it in a partial and successive way. There is in that and all through the description no intimation whatever of what was attempted in the patent under discussion.

The next Witherow Patent will be found on page 944 of the record, and the claim is:

> "1. The combination of a blast furnace with a storing receptacle provided with tuyeres for receiving and holding the fluid cast of the furnace, a distributing ladle, and conducting spouts for transferring the metal from one to another, substantially as and for the purposes described.
>
> "2. A storage receptacle for containing and dispensing fluid metal provided with a tuyere or tuyeres for supplying a blast of air or gas to maintain the metal in a fluid condition, and a suitable tapping hole, substantially as and for the purposes described."

Surely this is nothing but a storage vessel with the incidental mixing, and it is not a continuous process kept up by the continuous introduction of new material to supply what was taken out, and to keep up a general uniformity.

There is also the Abel-Durfee Patent of the 6th of March, 1872, which will be found on page 976. The first claim is:

> "Combining, converting vessels with reverberatory furnaces and blast or smelting furnaces in such

> wise as that the crude iron can be tapped and run or carried, raised and poured from the blast furnaces *into the reverberatory furnaces*, and then after *being treated* as may be desired be tapped out and run into converters, substantially as and for the purposes described and specified."
>
> "SECOND. Combining *converting vessels* with *reverberatory furnaces and cupola furnaces* in such wise as that the metal melted in the cupola furnaces can be run from thence into the *reverberatory* furnaces, and from the latter to the *converters*,substantially as and for the purposes described and specified."

But in the description of his patent at the top of page 980 Abel says:

> "When the metal has been poured into the gas furnace it can be treated in any *desired way to refine it*, and any metals or alloys of metal can be added at will. The iron in the gas furnace can thus be kept at any given standard and part of it tapped out from time to time," etc.

On page 978 he calls it "a reverberatory furnace, * * * wherein it [the molten metal] may be mixed with other irons, and be so treated as to insure the metal from time to time tapped out for conversion, being as nearly as practicable of a uniform character." Then he adds: "So many and so large furnaces may be used as the work in progress may demand, but in many cases *one* furnace of about *double* the capacity of the converter in use will be sufficient, as the necessary correction of the character of the crude iron can be very quickly made." "One furnace of double the capacity of the converter" hardly seems to teach the process we claim.

A careful examination of the last paragraph on page 979 will show what the above quotations have already shown: that the sole idea in the mind of the inventor was the establishment of a reverberatory furnace, whereby metals should be treated so as to produce that uniformity which would render them advantageous as a charge for the converter, one of his specifications being that the reverberatory furnace might contain enough for two charges. Surely, this is very far from establishing the succession of mixtures, which, by reason of their slight lack of uniformity each with its predecessor, left it in the power of ordinary skill to anticipate and control that difference.

The patent which is especially relied on by the Circuit Court of Appeals is the Deighton Patent, of the 11th of November, 1873. That patent will be found on page 982 of the record.

The witness Durfee, on page 254, says:

> "In the Deighton Patent the process described would be covered by claim 1 and also by claim 2."

This must be an error, because the only claim which seems at all to resemble this is the 6th, which is:

> "The system or mode of arranging and working Bessemer converters with a receiver or receptacle for mixing the molten metal from two or more smelting furnaces to get a more uniform quality of metal, substantially as hereinbefore described and illustrated by the drawings."

This language by no means covers the patent in dispute, even with all our subsequent knowledge on the subject. It is a matter of fact that it certainly did not lead to any finding out of the Jones process.

In the description on page 985 of the record, will be found a fair statement of what Deighton actually had in his mind, for he says:

> "My invention also consists in taking the molten metal directly from the blast furnace to the converter, in which case I prefer to arrange the

> Bessemer plant in a line at a right angle to a row of two or more blast furnaces, and place a vessel to receive the molten metal tapped from two or more blast furnaces to get a better average of metal, which will be more suitable for making Bessemer steel or metal of uniform quality."

This is simply a description of what everybody knows—that metal could be so mixed that a uniform character could be given to it. But this is not at all the Jones process, which is a continuous process resulting in continuous mixtures of molten metal and producing a degree of uniformity which in actual practice was sufficient to enable the man in charge of the converter to do his work and to produce a nearly uniform grade of steel. The most careful examination of all the facts that are produced in this case, and of all the literature displayed in this case, will demonstrate that no one had in mind, until the Jones invention, the idea of a continuous process by which the blast metal itself, as successively poured, should so mingle with the predominating pool which was left after each successive discharge, and be so controlled by it that a quasi-uniformity would be kept up which would be sufficient for all practical purposes. Undoubtedly a great many people had reached the point where they might have made our discovery; but they never did make it. But this is the commonplace of the history of patents. Given a great thing to be desired, and many strive for it. They almost fall over each other in the eagerness of their stride; but finally one touches the goal, and all the rest say they did.

It is the history of the telegraph and telephone, of the steam engine and the process of making glycerine, and of countless things of less renown.

The Judge in the Court of Appeals seems to find fault that nowhere in our patent is the language " a dominating pool " used. It does seem hard that an inventor should not also be master of language and be able to state, when he gets his patent in its most succinct form, the nature of the discovery and the processes which he has invented. Nevertheless, if any language, after discussion by other men, has been settled upon as a proper description, it is just as good a description as if it had been named by the inventor himself.

I shall not advert to the testimony of witnesses on behalf of the claimant. It is sufficient to say that Gayley and Kennedy, and above all, William Metcalfe, expressed the truth of the whole matter, when they said, in substance, that until the invention of Captain Jones there was no practical way of doing the thing which everybody so much desired. After his instrument and his process had become a success, others at once began to imitate it, and as usual in all patents of great importance, they began to think they had always known what they never did know, until the patent was spread upon the records of the country.

It has not seemed necessary to make much comment upon the testimony of the expert witnesses upon the other side.

Mr. Joseph Morgan, Jr., on page 380, expresses the state of mind and understanding which they all have with regard to the present invention. It reveals the cause of their erroneous opinions, and it shows that they have not taken the trouble to try to understand the patent in question, or, perhaps, have been so prejudiced that they could not understand it.

Mr. Morgan, quoting from Mr. Holly's report of 1877, says (p. 380):

> " 'The obvious remedy is to mix a number of blast-furnace charges, so as to reduce the irregularity to a minimum. Two systems of this are on the eve of trial; the one is simply mixing so few charges in a tank that the metal will be drawn out before it chills; the other is to store a large number of charges in a heated tank—that is to say, an immense open-hearth furnace.' "

Thus far Mr. Holly speaks, and thereupon Mr. Morgan declares:

> "This, to my mind, clearly discloses the method of mixing and of storage of metal of the patent in suit."

If Mr. Morgan so understood the matter, and is correct in such understanding, then we do not understand it. It seems to us that the witnesses on the other side have fallen into a common error; that is, of omitting the practical invention which was the continuous mixing, so as to secure not an exact and uniform mixture, but an ununiform mixture sufficiently alike from time to time in these portions that were carried to the convertors to enable persons of reasonable skill to complete the process. That constitutes our patent.

Whoever reads the testimony and the literature which is adduced in defense with this in mind will see that the same error prevails everywhere. If that expression of Mr. Holly's report which is quoted revealed, prior to our invention, our method, how does it happen that Mr. Morgan did not adopt our method before we invented it instead of after? If all these things made it clear to all these men, why was it not practised before they had an example of practical action set up in the Edgar Thompson steel works? When did Mr. Morgan build his 300-ton mixer, and use it as we do ours? After he had read Holly or after he had been to the Edgar Thompson works?

It seems to me when I consider the opinion of the Circuit Court of Appeals, and the way in which it has treated the file wrapper of the Jones Patent, that it is a good example of precisely what the law did not intend should be the attitude of the judicial mind towards a patent. The right of the patentee is secured to him in consideration not only of the fact that he has made a useful invention, but also in consideration of the fact that his success and the profits which may flow from it are to be an encouragement to inventive talent at all times. Therefore, the courts approach a patent, not with any dislike to the monopoly, nor with any disposition to find the patent void. The attitude of the Court is always favorable to the patent. If by a fair construction of language it can be found that the patent includes, in such a case as this, a new process hitherto unknown, that interpretation will be given to the patent which will effectuate the purposes both of Congress and of the patentee. But in the discussion of the file wrapper and the history of this case it would seem as if the Court approached it with the idea of finding no patent if there was any justification therefor. The fact that the patentee claimed too much, the fact that his original purpose was not clear, and that he modified it in accordance with the suggestion of the Patent Office, is not in any way unusual; in fact, the preliminary proceedings are for the very purpose of guiding the patentee in the selection of words to describe the things which he has invented, separate and apart from those known before, in regard to which he is entitled to no particular consideration. By that process the inventor often learns not his invention, but the practical boundaries of it.

The remaining question in the case is the question of infringement.

If it once be established that the process is novel and meritorious, and suitable for the issuance of letters patent, and that the same process is practiced by the complainant, the question of infringement is at an end. Now, it so happened that in this case, for convenience of the defendant's attorney, a stipulation was entered into. By that stipulation it was declared that the practice at the Cambria Works was such that while, as a rule, a considerable quantity (enough to constitute a dominant pool, although that language is not used) was left, nevertheless, the charge was said to be reduced from fullness to nothing. That might express the extreme range of their action, and in point of fact it is the extreme range which one can give it under our Sabbath laws and Sabbath sentiment, for at the end of the week the reservoir is empty and the process commences again; but this is merely an incident arising from our habits and customs, while, if they were otherwise, the process would be absolutely continuous instead of being only continuous for a week. It seems to me that that stipulation in itself covers the whole ground; but, in order to make sure, direct testimony was introduced, or rather, upon testimony being introduced, it was discovered that the process was the same in every way as that used at the Edgar Thompson Steel Works, and their engineer, Mr. Morgan, admits it expressly. Notice was given that that stipulation would not be relied upon, but that direct testimony would be relied upon. Thereupon the respondent put their chief engineer on the stand, and, upon being questioned, he said in substance that the practice was the same in both places. This would seem to be absolute in respect to the matter, and it seems hardly possible that the Court would insist not only upon the stipulation covering the matters, but upon the stipulation in its narrowest interpretation. But in truth and in fact a fair interpretation of the stipulation covers the entire ground of our claim, and shows clearly an infringement. Having this proved the novelty of our patent and the patentability of the process and the nature of it, and the respondents having practiced it, the judgment of the Circuit Court of Appeals should be reversed.

As suggested above, we cannot flatter ourselves that we have been able to better the argument presented by the Circuit Court in making its original decision in our favor. All we can hope to do is to state it in perhaps a little different form, and thus attract the attention of the Court, so that a thorough examination will be made, which we are confident will absolutely justify our contention.

This action is one of grave importance not merely on account of the pecuniary interests at stake, or on account of the voluminousness of the testimony introduced, or the fierceness of the contention. Iron and steel manufactures are to-day at the basis of civilization, and they will be no less so in the future. Whatever hope we may have of foreign commerce in this great staple, needed for railroads and building construction all over the world, rests upon the past and future inventive faculty of people who devote their time and attention to the consideration of these matters. The invention of Bessemer steel, the importance of Mr. Mushat's method in applying the spiegeleisen, and the invention of Captain Jones in providing a method of direct process from the furnace to the ingot, and perhaps I may say to the rail and the beam, has rendered available one of the greatest resources of this country, and makes possible our commercial dominion over the world. The spur which invention has is the result, as shown by the history of the country, which comes from the inventions of the human mind. The Constitution provided for the encouragement of inventive talent, and there never has been at any time, although the odious word "monopoly" could be freely used, a disposition on the part of the people of the United States to lessen the incentives offered to the inventive effort of the human mind. In this very case, the importance of the transaction is at least shadowed forth by the fact that nearly $300,000 was spent in this experiment, conducted against the impressions and beliefs of men who had certainly a right to give an opinion from their knowledge and skill in the business; and this $300,000 was only a fraction of the expense, as the Court may readily see, of the disarrangement of the affairs of a great establishment while this apparatus was being prepared to take the place of the other apparatus, which had forever passed away. When we consider that men were willing to expend such large sums and to disarrange their business to such a grievous extent, we will see that it is a matter of the gravest importance. That view will be further strengthened by the fact, testified to by witnesses and known to-day of all men, that this method is the one which is adopted as fast as the old apparatus can be done away with. One can hardly imagine a stronger incentive than is here offered for the preservation of this patent, not only for what it has done and what it will do of itself, but also for the encouragement of inventors all over the world.

THOMAS B. REED,
Of Counsel.

No. [illegible] [illegible]

THE CARNEGIE STEEL COMPANY, LIMITED,
Copartnership, Petitioner,

vs.

THE CAMBRIA IRON COMPANY.

*On Writ of Certiorari to the United States
Circuit Court of Appeals for the Third Circuit.*

BRIEF FOR THE CARNEGIE STEEL COMPANY, LIMITED.

PHILANDER C. KNOX,
[illegible] W. [illegible],
for [illegible].

THOMAS B. KERR,
of Counsel.

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IN THE

Supreme Court of the United States.

No. 146, OCTOBER TERM, 1900.

THE CARNEGIE STEEL COMPANY, Limited, Complainant, Petitioner,

vs.

THE CAMBRIA IRON COMPANY.

On Writ of Certiorari, to the United States Circuit Court of Appeals for the Third Circuit.

BRIEF FOR THE CARNEGIE STEEL COMPANY, Limited.

STATEMENT OF CASE.

The bill in this case was filed on December 2, 1895, by the complainant, The Carnegie Steel Company, Limited, charging the defendant, The Cambria Iron Company, with infringement of Letters Patent No. 404,414, granted on June 4, 1889, to William R. Jones and assigned by him to the complainant. The patent is for a method of mixing molten metal in such a way as will complete the continuous process of making steel direct from the blast furnace. The answer averred anticipation of the patent and contained a qualified denial of infringement, (Rec. pp. 6-7). The case was heard before the Circuit Court, and on September 5, 1898, the opinion of the Court was filed sustaining the second claim of the patent in suit, which was the only claim upon which the complainant relied at the hearing, and holding for the complainant on all the points at issue. The Circuit Court found affirmatively:

(a) The process stated in the second claim was patentable.

(b) It was not anticipated by the prior efforts to the same end.

(c) It was of vast utility and importance, as it quickened and cheapened the production of steel.

(d) The defendant used the process and therefore infringed.

A decree having been entered for an injunction and an account in accordance with this opinion, the case went to the Circuit Court of Appeals, on appeal of the defendant, and on August 21, 1899, that Court filed its opinion and ordered the decree of the Circuit Court to be reversed and the case remanded to that Court with directions to dismiss the bill.

The reason assigned by the Court of Appeals for its decision is contained in the concluding paragraph of the opinion, (Rec. p. 1122), as follows: "For these reasons we are of the opinion that the defendant's device does not infringe the second claim of the patent in suit."

The opinion of the Circuit Court is printed at page 673 of the Record, and is reported in 89 Federal Reporter, 721. The opinion of the Circuit Court of Appeals is printed at page 1117 of the Record, and is reported in 96 Federal Reporter p. 850.

On October 18, 1899, the complainant filed in this Court a petition for writ of certiorari, which was granted, and the case now comes before this Court in obedience to that writ.

ASSIGNMENTS OF ERROR.

The Circuit Court of Appeals erred in the following particulars:

1. In ruling that the defendant had not infringed the second claim of the patent in suit, and in not ruling that the said claim is valid and had been infringed by the practice of the process of the defendant.

2. In treating as conclusive proof of the process of the defendant, a stipulation between counsel, which complain-

ant's counsel had in due time repudiated for mistake, and concerning which the respondent subsequently introduced testimony upon which the complainant has a right to rely.

3. In giving to the patent a construction which deprives it of its just scope and effect.

THE NATURE OF THE PATENTED INVENTION.

Defendant's counsel have so frequently argued that the Jones process as practiced by the complainant, and which the defendant has copied, is not the invention stated in the second claim of the patent in suit, that we preface this brief with a short statement, in which we define the Jones invention in the words of the patent. The patent itself is the best answer to the argument that it does not describe and claim the invention as it is practiced.

1. *The purpose of the invention*—(claim 2). "To secure uniformity" of the molten metal "preparatory to further treatment." page 871, "The primary object of my invention is to provide means for rendering the product of steel works uniform in chemical composition."

2. *The steps of the method.* In the language of claim 2 —"Introducing into a mixing receptacle successive portions of molten metal ununiform in their non-metallic constituents (sulphur, silicon, etc.), removing portions only of the composite molten contents of the receptacle without entirely draining or emptying the same, and successively replenishing [filling-up again] the receptacle with fresh un-uniform additions." In the language of the specification, page 873, paragraph 1, "that when the metal is poured out of the spout a considerable quantity may always be left remaining and unpoured, and that whenever the vessel is replenished there may already be contained in it a body of molten metal with which the fresh addition may mix." And on page 874, paragraph 3, "The tilting of the vessel does not, however, drain off all the contents thereof, a portion being prevented from escaping by reason of the elevated position of the spout 6, and as the vessel is replenished from time to time, each new

charge mixes with parts of the previous charges remaining in the vessel."

3. *The mode of operation*—(Specification, p. 873, paragraph 1, and page 874, paragraph 3, immediately following the above quotations). "I thus secure, as much as possible, uniformity in character of the metal which is fed to and discharged from the tank, and cause the fluctuations in quality of the successive tappings to be very gradual." . . . . "By which means any sudden variations in the quality of the metal supplied to the converter is avoided."

THE IMPORTANCE OF THE INVENTION.

William R. Jones, the manager of the Edgar Thomson Steel Works of the Carnegie Steel Company, invented a process of mixing molten metal for use in steel works, which enabled him to secure uniformity of product, while at the same time dispensing with a tedious and expensive treatment intervening, under the old practice, between the reduction of the ore in the blast furnace and its conversion into steel at the converters.

The importance of this invention to the art can not be overstated. Indeed, its great and world wide value, and the gravity of the rights of the inventor and the defendant, are stated by the Circuit Court as an apology for the exhaustive and scholarly opinion wherein may be found a lucid exposition of the principles upon which the patent rests and their application to steel production.

The Commissioner of Patents in his report for the year of its birth (Rec. p. 868), specifically calls attention to the Jones process patent as one marking the growth of the industrial arts.

It should be here marked that not one of the findings of the Circuit Court as to the validity of the patent or its vast utility is seriously questioned by the Court of Appeals.

The process of Jones is the process that realized the oft expressed hopes of Sir Henry Bessemer and other great manufacturers—that at some time it would be possible to make steel directly from molten metal taken from blast furnaces, without the expense and delay incident to the intermediate cupola process, the only successful method of making Bessemer steel until the Jones method was perfected.

To understand this and its application to the case, it is well to call attention to the history of the art, concerning which no question has been or can be raised.

Prior to Bessemer's discovery of the great principle that iron contains within itself the ingredients for its own purification, and that it can be purified and refined without the use of fuel by blowing a blast of air through a molten mass, thereby consuming the silicon and carbon and other non-metallic constituents, and thus fitting it for immediate conversion into steel by re-carbonization, there had been no such thing known as the production of steel for the grosser uses, such as rails, bridges and structural purposes. Such steel as was produced, for cutlery and use in the finer arts, was the product of puddling furnaces and crucibles, and, as will be seen, the invention of Bessemer was the first great step in the art of steel making, as it is now known to the world.

In this Bessemer process of purification the carbon is destroyed, and, after the destruction of the carbon and other non-metallic constituents, the mass becomes pure iron, which is re-carbonized to make steel. The inventor of the present method of re-carbonization was Mr. Mushet, who accomplished it by the introduction of spiegel-eisen while the iron in a molten state was being poured out of the converter in which it was purified, thus converting it into steel. This was the second great step in the art of making steel.

The third and final step in the perfection of the Bessemer process is the one with which we are now dealing. The discovery was a process making practical Bessemer's theory, that steel should be made directly from the molten metal, as it comes from the blast furnace, without having to pass through the intermediate or cupola process, which involved casting the furnace metal into pigs, which after becoming cold, were assorted, broken up, recharged and remelted in a cupola furnace, and then placed in a converter for conversion into steel. The Jones method eliminated altogether this remelting in a cupola.

As has been said, Bessemer contemplated the direct process for the conversion of iron taken directly from the blast furnace, and believed that it was a valuable part of his invention (Rec. p. 833, para. 6). The experience of manufacturers, however, demonstrated the impossibility of successfully refining iron without casting it into pigs, selecting or mixing the pigs and remelting them. (Testimony cited below, p. 97, para. 5.) This was necessary because of the un-uniformity and irregularity in the non-metallic constituents of the molten blast furnace metal, which resulted in such un-uniformity in operation of the converters, and in the finished product, as to bar its use. This was the experience of steel makers throughout the world with the exception of one or two in Europe, where, owing to the peculiarly uniform character of the ore used, the direct process was carried on with measurable success; but in the United States, it was never undertaken without being abandoned, except by the Carnegie Steel Company, which, in the hope of realizing its tremendous economic advantages, struggled along with various modifications of method, until the discovery of Captain Jones made it the perfect success it is to-day.

In a later portion of this brief we make citations from the record in support of the foregoing, showing that some method to accomplish what Jones actually did accomplish was a great desideratum in the art, and one towards which its greatest inventive genius had been directed, and showing also its actual accomplishment by Captain Jones.

These positions were unassailed by proof or argument in the Court below, affirmatively found and elaborated in the opinion of the Circuit Court, and unchallenged by the Circuit Court of Appeals.

Treatment of Iron in the Converter.

Pig metal suited for the manufacture of steel contains a high percentage of carbon and silicon,—from three to four per cent. of carbon and from one to two per cent. of silicon. When an air blast is blown through a molten charge of such metal in a converter, the oxygen combines with and burns out the carbon and silicon. The burning of the carbon affords relatively little heat to the metal, for the product of its combustion, CO_2, is a gas, and as it passes off into the atmosphere, it carries much of its heat with it. The silicon, however, acts as a fuel, and its combustion by the air-blast imparts to the metal an intense degree of heat. The heat-giving property of the silicon is due largely to the fact that the product of its combustion which is silica, is not a gas, and does not escape into the atmosphere, but remains in the converter as a molten slag or cinder, and all of the heat produced by its combustion is utilized in heating the metal. If it were not for the heat thus generated, the metal, whose melting point rises as the carbon is eliminated, would rapidly solidify in the converter, and would spoil the process by preventing the passage of air. The silicon of the metal is, therefore, the heat-giving element.

When finally the silicon and carbon have been burned out, the metal is poured from the converter into a receiving ladle, where a highly carburized alloy of iron and manganese, known as ferro-manganese or spiegel-eisen, is added to it. The carbon of this alloy serves to recarburize the metal to the degree required in the steel, and the manganese reduces the ferric oxid with which the metal is always contaminated in the converting process and which, if left, would render the steel red-short.

The re-actions of the converter occur very rapidly. The entire operation lasts only about ten minutes, and the attendants must be alert and quick. The most important matter is to keep the temperature of the bath within bounds, and here there are two controlling factors—the initial or sensible heat of the molten metal delivered to the converter, and the percentage of silicon which it contains. If the molten metal is unusually hot when it is charged into the converter, or if it contains a high percentage of silicon, in either case the heat generated in the converter will be correspondingly great, and if not properly controlled, over-blown or wild "heats" will result, which can only with difficulty be deoxidized with manganese, and produce irregular and defective steel. If, on the other hand the initial temperature of the metal is unduly low, or if the silicon content is insufficient, such defect, if uncorrected, will produce cold heats, which will solidify in the ladle, forming skulls, which are fit only to be broken up and remelted as scrap.

The character of the blow is indicated by the color of the flame, which comes from the mouth of the converter. When the converter-man or blower sees that the blow is too hot, he seeks to correct it by throwing into the converter steel scrap, sometimes in large quantities. Such scrap being cold abstracts heat from the molten metal, just as ice does when added to hot water. Steam is sometimes blown in with the air through the tuyeres for a like purpose.

The blower can control a cold-blowing heat by reducing the amount of scrap or omitting it altogether. An excessively cold heat may be side-blown; *i. e.*, the converter may be turned on its side so that a portion of the air-blast will pass over the surface and will generate heat by burning the iron itself. This increases the heat; but it does so only at the expense of the iron. It is therefore a wasteful practice.

In some Bessemer mills trained workmen, known as scrappers, are employed to add scrap to the converter. The work requires promptness and skill, for the re-actions are rapid, and the scrapper must decide quickly what treatment he must give to the metal to correct any abnormal working. As much as 8,000 to 9,000 pounds of scrap have to be added to a very hot-blowing charge, and the amount of scrap required may vary from this great weight down to nothing (Mackey, p. 477). If the workman scraps improperly his mistake may be irremediable. If he adds too much scrap a chilled heat will result; if he adds too little, and thus fails to reduce the working of the converter to its normal limits, other evil results will follow.

Complainant's witness, Fry, says (Rec. p. 490):

"If the change is in the direction of colder-working metal he would leave off a certain amount of scrap in his converter, or, if too cold, he would turn the vessel in such a position as to burn iron to make heat, technically known as side-blowing, an exceedingly wasteful process. On the other hand, if the change is in the direction of hot-blowing metal, he would increase the amount of scrap added or blow in steam with the air, or both, as the necessity might indicate. There is very little time to come to a decision. The blower must make up his mind promptly. If he makes a mistake in either direction, the steel is liable to be spoiled."

The reason why, prior to the Jones invention, manufacturers preferred to undergo the expense of remelting blast furnace metal in cupolas instead of using the "direct process" was the irregular and sudden fluctuations which occurred in the temperature and chemical composition of the direct metal.

Blast furnace metal is irregular in its contents of silicon. One charge of metal tapped from the furnace may be high in silicon; the next tapping may yield metal of a very low silicon content. Frequently there are radical and material variations between different portions of the same cast or different portions of the same pig, and the irregularity is, of course, increased when pig metal is drawn from several furnaces. The cause of this is explained in an interesting manner by complainant's witness, Gayley, on pages 26, 31, 549, q. 194; p. 597, q. 403, to whose testimony we refer. Changes in the volume or temperature of the slag, and slight changes in the moisture contained in the air-blast will produce great variations in the silicon content of the blast furnace metal. The amount of moisture which enters the furnace with the air which is blown in immense volume through the tuyeres, may vary suddenly to the extent of 100 gallons of water per hour because of changes in humidity of the atmosphere (Rec. p. 597). Add to this the frequent changes in the character and composition of the ore, coke and limestone flux with which the furnace is charged, and it will be readily understood why the product of a blast furnace is not of constant character. Variations occur, not only in the chemical composition of the pig metal, but in its actual temperature, and this may arise from changes of heat in the blast furnace, or from loss of heat after it is tapped therefrom. Both the chemical and thermal inequalities are disturbing factors in the Bessemer converter.

The difficulty experienced in employing the "direct process" in Bessemer converter practice is due to the causes just mentioned. Metal which is irregular, either in composition or in temperature—one is as bad as the other—produces irregularity in the re-actions in the converter, for hot blows will follow cold blows, and cold blows will follow hot blows, in such uncertain and unexpected order that, do what he can with scrapping, side-blowing and steam injection, the converter man, being unable to foresee the character and extent of each change before it is developed suddenly by the altered appearance of the flame, often fails to apply the appropriate remedy, applies it sometimes too little and sometimes too much, and thus fails to correct the changing conditions. The ingots and rails made from such uncontrolled heat will be irregular and unsound. Thus it is that non-uniform chemical composition of the molten blast furnace metal, by making irregular and uncontrollable the action of the converter, yields steel products, such as railway rails and beams, which are not only irregular chemically, but are of irregular and uncertain physical condition—some sound, others of imperfect strength and full of flaws.

The consequence of the facts above stated was that, although the great saving which would arise from charging the molten metal directly from the blast furnaces to the converters offered a constant inducement for the adoption of such practice, it was not until the invention of Jones had been made known that steel-makers generally ceased to select and remelt their Bessemer pig-metal in the cupolas. Such remelting cost more than 60 cents per ton; and the coke used in the cupola furnaces contaminated the metal with sulphur; but notwithstanding all these disadvantages the cupola practice remained the most popular and the best. It was the only known way by which uniform metal could be secured for the converters. The few firms who used "direct metal" gained but an uncertain advantage. Later in the brief we cite the testimony bearing upon this point. The specification of the Jones patent in suit states, bottom of p. 871:

"Especially is this so in the process of refining crude iron taken from the smelting furnace and charged directly into the converter without remelting in a cupola, and although such direct process possesses many economic advantages, it has on this account been little practiced."

THE PRINCIPLE OF THE JONES INVENTION.

All of the many schemes which, prior to the invention of Captain Jones, were suggested for obtaining better "direct metal" for use in converters, had for their object to produce metal which would be of a constant standard of composition and temperature, and would thus imitate, as far as it could be imitated with blast furnace metal, the dead level of substantial uniformity which it is not difficult to obtain with metal remelted in cupola furnaces. The method of Jones, which is set forth in the patent in suit, proposes a plan strikingly different from this.

The principle which underlies the Jones invention had never before been utilized in the art—namely, that although the irregularity in composition and temperature of blast-furnace metal renders it impossible to be used directly with advantage, and although it is impracticable by any simple operation of mixing to produce from it converter charges of con-

stant composition, yet it is quite feasible to use it with success by bringing it to such condition that the fluctuations "are very gradual," i. e., so that each converter charge will differ only slightly in chemical composition and sensible heat from the charge next preceding and the charge next succeeding it, although there may be wide differences between the composition or temperature of charges at different parts of the same day or of the same week. All this is accomplished by the method stated in the second claim of the patent in suit.

The method which Captain Jones invented to accomplish the result just stated consisted in introducing the large tapping or cast of metal from the blast furnace in successive portions into a mixing vessel, removing from the large body of metal in such vessel portions for the converter charges, and successively replacing the charges so withdrawn with fresh additions of molten metal. Captain Jones perceived that by using metal so treated the fluctuations of the metal, although not prevented, would be rendered "very gradual," and that this would enable the converter-man to manage successfully heats of metal which differed widely from each other in composition and temperature and to obtain regular products; because, knowing at the beginning of each heat that it would be nearly like the heat preceding it, he could accurately correct its irregularities by proper adjustment of scrap or by other means at his disposal for such purpose. This principle of so treating the metal by a peculiar and appropriate process of mixing as to produce a grading of the converter charges, making each successive charge to differ but slightly in composition and heat from the charge before it, underlies the invention stated in the second claim of the patent in suit, and is not to be found in any of the publications or practices upon which the defendant relies.

Complainant's witness Fry says (p. 518):

"x-Q. 168. Then the Jones mixer, as you saw it used at Edgar Thomson, did not give entirely uniform results?

"A. Not at all, nor did the inventor, as I understood him, comprehend such, but, on the contrary, he recognized the practical impossibility of rendering uniform a continuous supply of metal, and desired only to reduce the abrupt changes of the several portions added to the gradual changes of the portions withdrawn, and this is what he worked out from his invention in a thoroughly practical way."

Mr. William Metcalf says (q. 14, p. 622):

"I understand and know the Jones method to be, as described to me by Mr. Jones, and as I have often talked it over with engineers, a method which by the use of a large closed vessel he is enabled to take the metal from a blast furnace in successive portions, and by introducing it into this receptacle and keeping it there a sufficient time, to produce not a uniform mixture of iron to take out of that vessel, but a mixture of iron which changes so slowly in its composition, as compared with the sudden and violent changes in the blast furnace, that he practically eliminates the difficulty in using direct metal, gives to his blowers a metal which they can handle and manage successfully from day to day, without producing skulls and cold heats on one hand, or overblown and wild heats on the other."

Mr. Julian Kennedy says (p. 446):

"Not only does this method cause the chemical composition of the metal to change slowly and gradually, but the same effect is produced on the temperature of the metal, and any wide variation of temperature is equalized and controlled in the same way as the chemical composition. This is important from the fact that the heat generated in the converter is dependent on the initial or sensible temperature of the charge as well as on the amount of silicon present, the silicon being the principal fuel or heat-giving element in the Bessemer process, and more silicon being required for successful operation when the initial temperature of the iron charged into the converter is low. * * *

"The Bessemer process, unlike the open-hearth process, requires that the operation be terminated at exactly the right moment. If the vessel be turned down and the blast shut off too soon, there will be some carbon left in the iron; and, if it be turned down too late, the iron will be overblown or partly oxidized. To stop the operation at exactly the right time requires not only long experience and great skill on the part of the blower, but also sufficiently uniform iron. For example, the blower who has been working on low silicon iron and is suddenly provided with high silicon iron, will generally have to blow several heats before he succeeds in stopping the operation at exactly the right time. Wide variations in the composition of separate heats are, therefore, both troublesome and expensive, and if widely different irons follow each other the blower is very apt to make irregular and unreliable steel. Not only is it difficult in such cases for him to tell the exact time when the operation should be stopped, but it is difficult to control the temperature of the metal in the converter, so that the steel produced is apt either to be too cold or too hot for successful casting. Hence, defective ingots, flaws and brittleness in the finished product.

"In the open-hearth process, when the steel is supposed to be finished it is quite feasible to take out a sample and test or analyze it, and if the composition is not right it can be changed by adding additional material to the molten steel in the furnace. The Bessemer process on the other hand, instead of taking from six to eight hours to make a heat, takes as many minutes, and a variation of a few seconds from the time of stopping the process may mean the difference between good and bad steel, so that it is very important that the iron delivered to the converter should be as uniform as possible; and it is also important that all changes in the composition and initial temperature of the iron should be as slow and gradual as possible, so that the blower may not be called upon to blow successive heats of widely varying behavior in the vessel. Such slow and gradual change also allows the foreman to judge very accurately how much scrap should be added to control and keep uniform the temperature in the converter.

"A. (p. 471). Uniformity is a relative term. What is wanted in Bessemer practice is not so much that the silicon, for example, in the metal shall always be the same, as that it shall vary slowly and regularly between successive changes. Metal can be used in the converter having all the way from 1 per cent. to 2½ per cent. of silicon without serious trouble, providing the change is made gradually, so as to allow the blower and scrapper to work intelligently."

JONES' METHOD OF OPERATION NEW.

Not only was Jones the first to utilize the principle above stated, but the mode or combination of steps by which he put it into practice was likewise original. Jones proposed to tap the molten metal from the blast furnaces into ladles,—in practice a 50-ton tapping from a blast furnace is distributed into five 10-ton ladles,— and to carry and pour them into a large covered vessel having a fixed cover, known as a "mixer," mounted upon trunnions and holding 100 tons or more. When the mixer is full or substantially full of blast furnace metal, the converter charges of about 10 tons each are poured out into ladles mounted on cars which are successively drawn beneath the mixer's spout, and when filled are taken off and emptied into the converters as needed.

The mixer is never allowed to become empty. As the charges are withdrawn and taken to the converters, the mixer is replenished with fresh additions of molten metal. In practice, a number of full ladles stand grouped around the receiving end of the mixer ready to be poured into it to replace the withdrawals as they are made. In this way a considerable pool of metal is maintained constantly in the mixer, and as each charge of metal for the converters represents in character the average of the large number of charges contained in the mixer, and differs from the preceding converter charge only to the extent of the small degree of dilution caused by the ladleful of blast furnace metal which has been added to replace the preceding charge, it follows that the difference between successive converter-charges will be but slight, although the absolute composition of the metal at the beginning of the day's work may differ widely from the metal taken from the mixer at the end of the day.

The mixing is not a simple mingling together of charges or portions of metal from different sources, but is a mixing of such charges with a governing body or pool of metal already in the mixer.

The operation is continuous. Each ladleful of blast furnace metal must pass through the pool on its way to the converter, and no matter how it may vary in heat and composition from the preceding ladleful, its individuality is lost in the pool, and its evil effect on the operation of the converter is prevented.

The changes of character in the metal withdrawn from the mixer are extremely gradual, so that the converter man has no difficulty in keeping pace with them and in so scrapping or otherwise treating the bath to suit the character of the blow, as to produce a uniform product from a metal which may vary within wide limits.

Each blow serves as an index of the next.

The blower is assured that a very hot blow will not be followed by a cold blow, nor a cold blow by a hot blow. The blow which he is about to work will probably be about the same in character as the preceding one. In any event, it will blow only a little hotter or a little colder. The treatment which it will require will be nearly the same.

The constant succession of additions of portions of molten metal keeps up the temperature of the mass contained in the mixer and prevents chilling or skulling, without deteriorating the metal, as would be the case if it were heated by a furnace flame. The actual temperature or sensible heat of the metal charged into the converter as well as its chemical composition, is thus graded and controlled, so that it no longer constitutes a disturbing factor in the Bessemer process. However diverse may be the temperature of the lots of metal taken from the blast furnace, the changes in the temperature of the withdrawals from the mixer will be free from sudden and violent fluctuations. Mr. Metcalf says (p. 627):

> "In the Bessemer process sudden and violent fluctuations in *temperature* are liable to cause almost as disastrous results as sudden and violent changes in composition." * * *

The characteristics of the Jones invention have been stated with great accuracy in the opinion of the Court below (p. 673).

In this connection also it is important to notice the tables of analyses produced by complainant's witness James Gayley, formerly superintendent of the Edgar Thomson Steel

Works. From these tables (p. 29) it appears that although the consecutive casts of metal taken from the blast furnaces vary in silicon from a small fraction of one per cent. to over one per cent., the average variation in silicon between consecutive analyses of metal taken from the mixer is only .121 of one per cent. On the other hand, the silicon in the total number of charges supplied in a day's run to the converters varies within wide limits. The record for a long period shows an average variation between the highest and lowest content of silicon of as much as .807 per cent. per day, and sometimes as much as 1.57 per cent. in a single day; and yet this wide range is passed through by such gradual changes as to be practically unnoticed by the blower. In its practical every-day working, the Jones method successfully takes charges of metal of widely varying composition and temperature, and modifies them, not by preventing the occurrence of changes, but by making the changes so gradual that they can be readily controlled and provided for by ordinary operations of scrapping, and so that the product of the steel works is made as homogeneous as would be possible with the most uniform metal obtainable by the best cupola practice.*

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*The following list of the extreme percentages of the silicon content of the metal supplied to the converters on the first 8 days of June, 1893, and on 8 days of April, 1894, may be taken as representative of the ordinary work of the mixer at the Edgar Thomson Steel Works, and illustrates the point stated in the text.

1893.	Highest Percentage of Silicon.	Lowest Percentage of Silicon.
June 1	1.35	.61
June 2	1.30	.70
June 3	1.12	.51
June 5	1.24	.70
June 6	1.26	.68
June 7	1.45	.56
June 8	1.73	.89
June 9	1.56	.82
Apr. 2	1.49	.65
Apr. 3	1.61	.98
Apr. 4	1.59	.89
Apr. 5	1.45	.63
Apr. 6	1.77	.93
Apr. 7	1.49	.75
Apr. 9	2.15	.98
Apr. 10	2.05	1.19

The Jones Apparatus also New.

Capt. Jones instituted between the blast furnace and the converters an aparatus for carrying on a new process—a vessel designed for the sole purpose of receiving and mixing the charges of molten metal and holding a large pool of the same; he provided one set of ladles for removing the converter charges as required and taking them to the converters, and another set of ladles for carrying the molten pig metal from the blast furnace in small lots, replenishing the mixer from time to time, and thus maintaining it substantially full of molten metal. The two sets of ladles and the intermediate mixing vessel introduced by Jones constituted a practical novelty. A new name, "mixer," was introduced into the vocabulary of the art, and this apparatus is now as well known and its value as highly appreciated as that of any other part of the machinery of a steel plant.

Instead of going directly to the converters each ladle of molten metal is carried in its car and poured into the pool which is contained in the mixer. This is the invariable practice. All the metal to be refined in the steel plant must first pass through this pool. If the supply at the converters runs short, they must wait until metal sufficient for their needs has been poured into and poured out of the mixer. The converters never draw their supply directly from the blast furnaces.

Mr. George Lauder says on this point (p. 66):

"A concise way of stating the difference between the three processes mentioned would be to note the different tools used in operating them. In the cupola process only one ladle is used; in the direct process one set of ladles is used, necessarily consisting of a considerable number of ladles; in the mixer process two sets of ladles are used, one set to bring the metal to the mixer, the second set to take it away from the mixer."

The process as above explained is the process which is described and claimed in the patent in suit.

The patent in suit states (Rec. p. 871):

"In practice it is found that metal tapped from different blast furnaces is apt to vary considerably in chemical composition, particularly in silicon and sulphur; and such lack of uniformity is observable in different portions of the same cast, and even in different portions of the same pig. * * * The consequence of this tendency of the silicon and sulphur to segregate or form pockets in the crude metal is that the product of the refining process in the converters or otherwise in like manner lacks uniformity in these elements, and therefore often causes great inconvenience and loss, *making it impossible to manufacture all the articles of a single order of homogeneous composition.* Especially is this so in the process of refining crude iron taken from the smelting furnace and charged directly into the converter without remelting in a cupola, and although such direct process possesses many economic advantages, it has on this account been little practiced."

The mischief, it will be observed, was not in the presence of non-metallic constituents in the iron, nor their presence in a greater or less percentage, but was the un-uniformity or fluctuation as between different charges in the converter, producing the mischief described by all the witnesses. Jones corrected this by (in the words of the second claim)

> "introducing into a mixing receptacle successive portions of molten metal un-uniform in their non-metallic constituents, removing portions only of the composite molten contents of the receptacle without entirely draining or emptying the same, and successively replenishing the receptacle with fresh un-uniform additions, substantially as and for the purpose described."

This requires but a glance to disclose that the spirit of his invention was the constant maintenance in the mixing receptacle of a dominating mass or pool of metal in which the successively injected charges would lose their identity and from which portions could be withdrawn for use in the converter representing the average of the un-uniformity of each part, accomplishing thereby the end desired.

The Circuit Court of Appeals found that the patent is not susceptible of this interpretation, in the following language (p. 1121, line 17):

> "We find nothing in the patent which warrants us in determining that the inventor had in mind that the residue to be left in the receptacle should form a dominating pool."

This, we humbly contend, is a fatal error of interpretation. The words "dominating pool" do not appear in the patent. It is a term adopted early in the case as descriptive of the function of that portion of the contents of the mixer allowed to remain in the receptacle, sufficient to effect the averaging of the different charges and securing practically homogeneous results.

In one part of the patent, the patentee refers to the quantity remaining as "considerable"; in other parts, synonymous terms are used; in all parts the idea stands out that sufficient must remain to accomplish the end indicated.

The language of the claim itself, however, is sufficient to illuminate this error of the Court of Appeals; indeed, the difficulty seems to lie in making the second claim more perspicuous by language and arrangement other than its own.

Thus, as stated in the claim, successive portions are introduced, making a composite body of metal, portions only of the composite contents are removed without entirely emptying or draining the same, but nothing is removed until the composition is effected; and the removals are replenished by fresh un-uniform additions. Again stated, the patentee's idea was, as claimed, to successively, (that is, following in order or uninterrupted course) introduce un-uniform metal until the contents formed a composite body, then remove portions only of the "composite contents" without emptying the receptacle, and successively replenish with other un-uniform additions. To replenish means to restore what has been withdrawn. "To fill again after being diminished." What, then, can be more clear than that, the composite mass once created and absolute directions given to replenish successively, (i.e., following in order or uninterrupted course) withdrawals therefrom, the patentee in the most specific terms, and without more, described a permanent pool, called dominating by common consent, because its function was to accomplish the purpose of the process, that is, blend the differing characteristics of the units of its composition into a composite whole.

The fact of a dominant pool, though it is true no such term is used, is the pith and marrow of Jones' claim. The word "replenish" of that claim (note its derivative significance *plenus*—full, and *re*,—again) in connection with the process shown in the claim, viz.: "removing portions only" and "successively replenishing," unquestionably show, that refilling the vessel, and therefore constant maintenance of fullness, was the one especial fact, the novelty Jones did claim. By the very laws of nature the inevitable sequence of successive replenishing, where portions only are removed, is and of necessity must be a permanently maintained (and therefore a dominant) pool.

Defendant argues that the purpose of Jones as described in the patent in suit was not to make uniform articles of steel by "causing the fluctuations in quality of the successive tappings to be very gradual" and thus making the working of the converter controllable ; and that this operation is not covered by the patent. We answer—

1. Jones doubtless thought that he was entitled by virtue of his practical pioneership in the art, to cover more than the method which he stated in the second claim, and with this in view he added the claim which appears as claim one of the patent. This claim is not here in issue, but it is clear that the portions of the specification upon which defendant's argument is based have relation to the first claim, and not to the second claim.

2. The complainant's witnesses agree that the great utility of the Jones invention as practiced results from making the fluctuations in quality of the metal gradual, by passing it through a governing pool so that the operations of the converter may be controllable, and a uniform product obtained therefrom, and that it is so used both in this country and in Europe. (Evans, p. 127, line 2; Lauder, p. 101, q. 4; Gayley, p. 40, para. 2; p. 891, x-q. 365). Nor is this denied by the defendant's witnesses.

Sir Lowthian Bell said (p. 855):—

> **"If they had too much silicon, there would be too high a temperature in the converter; and if they had the silicon too low, they would have too low a temperature. The consequence was an irregularity in the product, causing great waste of iron and an increased quantity of defective rails. . . . . The mixer held about 100 tons of iron and as they ran ten tons out at one end they ran ten tons in at the other. . . . . Since they had begun to use the mixer, the defectives, from whatever cause, had fallen to something like half of what they were before."**

3. The second claim in apt terms defines the very process which the defendant is using—"removing portions only of the composite molten contents of the receptacle without entirely draining or emptying the same, and successively replenishing the receptacle with fresh un-uniform additions."

It follows therefore under the well-known rule that an inventor is entitled to all the benefits and uses of his invention whether he recognized them or not, *Roberts vs. Ryer*, 91 U. S. 150, that defendant's criticism of the patent would not be relevant, *even if Jones had not described the advantages of his invention*, provided that he has set forth and claimed the invention itself and the manner of practicing it; but as a matter of fact Jones has described the uses and advantages of his invention in a way which cannot fail to be understood by any skilled steel maker familiar with the art and with the difficulties to be cured. *Loom Company vs. Higgins*, 105 U. S. 580, 585. On page 873, lines 3-12, Jones states that the spout of his vessel is so located that "a considerable quantity may always be left remaining and unpoured, and that whenever the vessel is replenished, there may already be contained in it a body of molten metal with which the fresh addition may mix. I thus [by the presence of this pool or body of metal] secure as much as possible uniformity in character of the metal which is fed to and discharged from the tank, *and cause the fluctuations in quality of the successive tappings to be very gradual.*" Here is an accurate description of what all the experts agree is the true nature of the Jones invention as stated in the second claim.

Again in the sentence beginning p. 874, para. 3, line 7, the same thought is emphasized—"the tilting of the vessel does not, however, drain off all the contents thereof, a portion being prevented from escaping by reason of the elevated position of the spout 6, and as the vessel is *replenished* from time to time each new charge mixes with parts of previous charges remaining in the vessel, *by which means* [*i. e.*, by reason of the body or pool of metal] any sudden variation in the quality of the metal supplied to the converter is avoided."

4. Defendants refuse to view the patented invention as a skilled steel-maker would view it. They ask that the patent be construed so as to cover what does not happen in the manufacture of steel, and to exclude what does in fact happen when the method set out in the second claim is practiced, namely, the prevention of the difficulties of working and the irregularities of product which are experienced when suddenly fluctuating metal is supplied to the converter. The silicon in the charge of pig metal is burned up in the converter just the same when the charge is high in silicon as it is when the charge is low in silicon. In either case desiliconized metal remains at the end of the operation; but if the percentage of silicon at the beginning of the blow is very different from the percentage of silicon in the charge at the beginning of the

preceding blow, the blower will be taken by surprise, and will fail to correct the heat properly. The consequence is that the product will be irregular—*First*, because of the irregular and uncontrollable temperature developed in the converter, and, ***Second***, because of the irregular amount of the recarbonizing additions which must be made to the converted metal to compensate for such irregularities. All this is corrected by the process stated in the second claim.

The sulphur is not removed in the converter, and irregular sulphur in the charge will appear as irregular sulphur in the steel. To that extent the argument of defendant's brief is true in fact.

Now these matters being of common knowledge in the steel-making art, are as if they had been set forth in detail in the specification; and defendant has no right, *while admitting their truth*, to ask that they be disregarded and that the patent be construed in the light of an incorrect and impossible theory of operation. In *Webster Loom Company vs. Higgins* 105 U. S., 580, 585, Mr. Justice Bradley said:

> "All these things were as well known as the alphabet to all those skilled in the art of pile weaving, as it then stood. With this mass of previous knowledge and nomenclature in their minds (as we must suppose it to have been), the language, the explanations, the drawings, and the claims of Webster's patent must have been perfectly intelligible to them. When an astronomer reports that a comet is to be seen with the telescope in the constellation of Auriga, in so many degrees of declination, and so many hours and minutes of right ascension, it is all Greek to the unskilled in science; but other astronomers will instantly direct their telescopes to the very point in the heavens where the stranger has made his entrance into our system. They understand the language of their brother scientist. If a mechanical engineer invents an improvement on any of the appendages of a steam-engine, such as the valve-gear, the condenser, the steam-chest, the walking-beam, the parallel motion, or what not, he is not obliged, in order to make himself understood, to describe the engine, nor the particular appendage to which the improvemen refers, nor its mode of connection with the principal machine. These are already familiar to others skilled in that

kind of machinery. He may begin at the point where his invention begins, and describe what he has made that is new, and what it replaces of the old. That which is common and well known is as if it were written out in the patent and delineated *in the drawings.* * * * *And as it can not* be expected that the Court will possess the requisite knowledge for this purpose, it becomes necessary that it should avail itself of the light furnished by the evidence to enable it to understand the terms used in the patent and the devices and operations described or alluded to therein. This evidence, of which the record in this case furnishes an abundance, being resorted to, we have no difficulty in comprehending the patent, or the nature of the invention therein described."

The words "Further Treatment" in claim 2.

An argument is based by defendant upon a difference in words between claims 1 and 2, claim 1 including as a step the "subsequent refining" of the charge, and claim 2 reciting the mixing of molten metal "preparatory to its further treatment." But defendant here overlooks the fact that in view of the specification these are merely different modes of expression of the same thought. The only treatment mentioned in the specification is "refining," and the specific form of refining mentioned is conversion.

"Treatment" in the sciences of chemistry and metallurgy means some operation which changes the nature of the matter treated. One treats a base with an acid, to make a salt; or treats pig-iron with air or other decarburizing agent as a step in the process of making steel. Hence "further treatment", taken with the context of the patent, with which it must be construed, means an operation such as Bessemerizing, or treatment in the open hearth furnace or some other refining of the metal. Conformably to this meaning, Webster gives the following definition of "treat" as a term of chemical science: "Treat. 6. to subject to some action, as to treat with sulphuric acid." We refer also to the proof afforded by the file-contents of the patent in suit, as to the meaning of the word "treatment" as Jones used it. See page 126 of this brief.

It is argued further that because the sentence on the last five lines of paragraph 3 of page 847 of the patent was not canceled by disclaimer, processes of casting the metal were included in the second claim by the word "treatment."

This is obviously not so. One expression in the said sentence on which this argument is based is that the metal is carried "to the converters *or casting house.*" It is plain that "casting" is not treatment, but the very opposite. It is laying the metal down *without treatment.* This is done in all steel works, when, for any cause, the converters get out of order and can not use the metal, and the sentence in question is simply a working direction as to what is to be done with the metal in case the converters are not ready to take it. The other expression in that sentence on which this argument is based is that the mixer is to "deliver its contents immediately to the converters *or other place where it is to be utilized.*" This seems to us to imply some other form of treatment or refining, *e. g.*, in an open hearth steel making furnace, and not the casting into pigs. The expression is "utilized," the material utilized is molten mixed metal. If the metal were cast into pigs this advantage would be lost, for the original heat would not be utilized. This matter was fully considered by Judge Buffington on page 668, para. 1.

We refer further on the subject of the patent in suit to the testimony of Julian Kennedy (pp. 445-447, q. 3).

What is meant by molten metal.

The defendant tries to show that the second claim of the patent in suit refers to melted metal of any description, and that it includes within its terms not only metal drawn directly from the blast furnace, but cupola metal as well.

It would avail nothing to the defendant, even if it could establish this contention; for the process of preparing metal for refining, in the manner claimed in the patent, is broadly new, and is not to be found in any prior manufacture of steel, whether from cupola metal or blast furnace metal. The contention is therefore irrelevant in view of the facts, and it is subject to the additional objection that it is not warranted by the specification or claims.

The specification refers only to molten pig metal or blast-furnace metal. It contains no reference to metal remelted in a cupola. By describing a process designed to dispense with the use of cupolas, it negatives such a suggestion.

THE NEED WHICH EXISTED PRIOR TO JONES' INVENTION.

Prior to the Jones invention there was a recognized need for some process which would make practicable the use of direct metal in the converters. This is shown by the history of the art. A notable instance was the experience of the Carnegie Steel Company. In 1882 they abandoned their cupolas and took their converter metal directly from the blast furnaces. They continued this practice for about six years. The attitude of the other American manufacturers was a waiting one, and the Cambria Iron Company, the defendant in this case, after having installed at great expense the ladle tracks and drying hoods incident to the direct process and observing its failure at the Carnegie Steel Company's Works and wherever else it was undertaken, abandoned its intention to operate in that way, and its apparatus remained unused until after Jones demonstrated the success of his method (Gayley p. 554). When that success was demonstrated, defendant sent its engineer to the complainant's works, copied its process and apparatus and has been using them constantly and with success ever since.

The six years' experience of the Carnegie Steel Company is instructive as to the difficulties attending the direct process. They used the most painstaking expedients for overcoming the irregularity of the metal, and among them some of the practices upon which the defendant now relies in anticipation of the patent in suit, but the result was uniformly discouraging. Mr. George Lauder, one of the members of the complainant company, says (Rec. p. 65):

"I will give a general outline of the history and operation of the Edgar Thomson works. The works were started about the year 1876, with what we called the cupola process for supplying metal to the converters. This process was used exclusively until about the year 1882. At this date we introduced what we called the direct process. * * * During the whole period of use of the direct process we had a great deal of trouble on account of the number of defective rails we made and the irregularity in quality of the first quality of rails we sent out. At times this reached such alarming proportions that we frequently discussed the question whether it would not be advisable to return to the cupola practice.

And to the same effect is the testimony of James Gayley (Rec. pp. 25-26) quoted by Judge Buffington on page 681 of his opinion.

The Vulcan Iron Works, of St. Louis, Mo., was designed to use direct metal, but until the final closing of the works, cupola metal only was used in the converters (Gayley p. 551, qs. 201, 202; Fry p. 495; Holley's Article, p. 796).

The difficulties of the direct process are graphically described by the converter-men who testify in this case. Their statements are uncontradicted, and are of peculiar interest because of their daily experience with the operations of the converter. M. J. Dowling, a converter mill superintendent at the Jones & Laughlin mill, says (p. 482), that the direct process resulted in the production of many chilled heats, skulled ladles, and much scrap. The amount of chilled heats was 50 per cent. more than was obtained in converting metal melted in the cupola. W. Y. Williams, converter-mill superintendent of the Johnson Company, at Lorain, Ohio (p. 485), describing the use of direct metal, says that the sudden alternations of extremely hot and extremely cold blows made it almost impossible to regulate the temperature. "The steel that we failed to reduce to a proper temperature would become brittle and unsafe, while the extreme cold heats would make more scrap."

Like difficulties were experienced at other works, as at the

Rensselaer Steel and Iron Company, at Troy, N. Y. (Sherrerd, p. 606, q. 7).

John E. Fry, a skilled Bessemer superintendent, * mentioned in one of defendants' exhibits (Rec. p. 821), as a man prominent in the art, says (p. 489, q. 5):

> "Prior to Jones' invention, metal direct from blast furnaces was used to some extent, but the product was variable, and much steel of inferior quality was made, which could be sold only at a reduced price."

Mr. William Metcalf, a metallurgist of national reputation, says (Rec. p. 621):

> "All of the evidence of the literature of the Bessemer process goes to show that for years there were serious efforts being made to devise a practical method of using the iron direct from the blast furnace, and to get rid of the serious trouble there is from the fact that a blast furnace is liable to change suddenly and produce an iron varying so much in silicon particularly, and also in carbon, as to cause very sudden changes in the working of the iron in the converter, rendering it liable at one time to have the vessels and everything skulled up by a cold heat, or have everything burned out and ruined by a too hot and wild heat * * * These extremes * * were such as to practically eliminate the benefit which it was well known would exist if the metal could be used directly from the blast furnace."

There was therefore a recognized and urgent need for some method by which the steel manufacturer could save the ex-

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*A tribute to the practical character of the complainant's testimony is the oft repeated criticism of defendant's counsel, that none of our witnesses discusses the Jones patent. Complainant's witnesses are without exception men who have had either long continued and daily experience as converter men, or who as in the case of Messrs. Fry, Metcalf, Kennedy and Gayley, have had actual direction and superintendence of the operations of steel plants. They all testify from the standpoint of practical men concerning the working of the Jones invention and concerning the evils of the "direct process." On these points their testimony is of great value, because it presents the Jones invention as the practical steel maker sees and understands it. But on the point about which defendant complains that our witnesses did not testify, their testimony would have been of a purely literary character and would have been incompetent, and of no value to the Court.

pense and avoid the contamination by sulphur incident to the remelting of pig metal in cupola furnaces, and could successfully make a good quality of steel from metal taken directly from the blast furnace. From the date of the invention of the Bessemer process down to the date of the Jones invention in suit, the need of dispensing with the cupola was commented upon and various schemes were proposed by metallurgists and patentees to meet the need, but although the plans which they proposed were given wide circulation, none of them proved efficient.

The history of the art as shown in the publications and the patents produced by the defendant is full of confirmation of this:

In a patent No. 122,312, granted on January 2, 1872, to Z. S. Durfee, it is said (p. 909):

> "In the manufacture of steel by the pneumatic or Bessemer process, a great saving of fuel and iron, of wear and tear of furnaces and of labor would be effected were it possible to make uniformly good products of the desired temperature by converting the crude iron immediately it is tapped from the blast furnace in which it is made. This plan has been and may still be practiced to a considerable extent; but it has been found that by reason of the irregular working of blast furnaces, and the consequently varying character and quality of the crude iron produced, it was always very difficult and in most cases impossible to secure such uniformity in the converted metal as was essential to success in the business. Hence at several establishments where the plan of taking the fluid iron as it was tapped from the blast furnaces and pouring it at once into the converter has been practiced, it has been abandoned, the proprietors preferring to incur the expense of handling and remelting the crude iron after it has been cast into pigs, in order thus to secure the advantage of carefully selecting and mixing the materials for each charge to be converted."

Except in Sweden and France, where the highly manganiferous character of the blast-furnace metal corrected to some extent its unequal character (Durfee's Paper, p. 791; pp. 833, paras. 1-3; p. 769, para. 2), the difficulties mentioned above were always encountered, and prior to Jones' invention, direct metal, when used at all, was only used reluctantly and with no real benefit.

THE ADVANTAGES OF THE JONES INVENTION.

The utility of the invention may be judged by its practical results, and by the extent of its adoption. The inventor was the late Capt. William R. Jones, then superintendent of the steel works of the Carnegie Steel Company, and in 1887 it was put into use by him at the complainant's Edgar Thomson Works at Braddock. It has since been adopted in all the principal steel works of the United States, and in many of the steel works in Europe, where its importance has received practical recognition by the payment of royalty to the owners of the European patents (Lauder, p. 67; Evans, pp. 82, 96-97). In the United States the Jones method is used by the Edgar Thomson Steel Works, of Braddock, Pa.; the Duquesne Steel Works, of Duquesne, Pa.; the Cleveland Rolling Mill Company, of Cleveland, Ohio; the Illinois Steel Company, of Chicago, Ill.; the Pennsylvania Steel Company, of Steelton, Pa.; the Maryland Steel Company, of Sparrows Point, Md.; and the Cambria Iron Company, of Johnstown, Pa. (Gayley, p. 546).

When the invention was first proposed by Capt. Jones it met strenuous opposition. It was thought that it would be inoperative or inefficient; that it would result in chilling the metal (Lauder, p. 65; Gayley, p. 27; Berg, p, 598, q. 7; James, pp. 604-5, q. 4). Mr. Andrew Carnegie gives the history of its introduction. He says (pp. 428-430, qs. 5, 8):

> "There were both advantages and disadvantages [in the direct process used prior to Jones' invention], but the disadvantages were so great that we often debated whether to abandon the process or not. We found it impossible to get uniform quality of rails, as well as by the cupola method.

* * * I remember being asked by the president of the Cambria Iron Company, Mr. Townsend, to tell him frankly what the result had been, as that company had thought of following our example. I told him of our difficulties.

"When we were still anxiously struggling with the problem, and undecided whether to continue or abandon it, Capt. Jones, our superintendent, a most ingenious man, told us that he believed he had invented a plan which would solve the problem. * * *We thought so well of the idea—I was so convinced of its reasonableness—that I directed him to go ahead with his invention. * * * Capt. Jones did so, and almost from that day our troubles ended. He had scored a tremendous success; another step forward was taken in the manufacture of steel, and we are using the invention today. * * *

"Without this invention I believe that we should have abandoned the mode of running direct from the blast furnace. Above all things the manufacturer has to regard the uniformity of product, the quality of rails, and this uniformity cannot be obtained without the Jones invention, as far as I know."

Mr. Lauder says (p. 68):

"We have found it [the Jones method] highly advantageous, both in respect of saving money and saving the anxiety we had while using the direct process."

The Jones invention has enabled the steelmaker to obtain for his converters even a better metal than that obtained from cupolas. It has reduced largely the percentage of scrap by preventing abnormally acting heats; it has enabled large quantities of iron from the blast furnaces to be utilized which otherwise would have to be rejected and remelted; and it has reduced from 6 per cent. to 4 per cent. the "seconds" or defective quality rails (Gayley, pp. 541, 590 x-q. 387). Mr. Evans and Sir Lowthian Bell report even a greater reduction of seconds (Evans, p. 82, q. 16; Sir L. Bell's remarks, p. 855, para. 2).

This important reduction of seconds has been effected, notwithstanding that since the introduction of the Jones invention the inspecting of steel rails has been much more exacting, and many rails are now counted as defective which before would have been rated as of good quality (Gayley, p. 593, x-q. 395).

The Jones method first made it possible to use blast furnace metal successfully in the converters without deteriorating the quality of the steel produced therefrom (Gayley, pp. 30, 37, q. 11).

Jones at one step has overcome all the disadvantages of the direct process. He has effected a saving of 63½ cents per ton over the practice in which the metal is remelted in cupola furnaces (Moreland, Rec., p. 73, q. 4; p. 585, q. 362). These facts are not controverted.

On the question of the practical results of the invention, we refer especially to the following portions of the testimony: Gayley, pp. 30-31; p. 585, q. 361; p. 541-542; Lauder, p. 67-68; Evans, p. 81-84; Carnegie, p. 428-430; Kennedy, p. 447-449, 458-459, q. 20; Fry, p. 489-490; Metcalf, p. 621-622, qs. 12-14; Sherrerd, p. 607, q. 8.

We refer also to the testimony of the following witnesses, who from the standpoint of intelligent workmen and foremen, testify to the advantages of Jones' invention and the disadvantages of the direct process; Dowling, pp. 481-483; Mackey, p. 477, qs. 16-27; Williams, p. 485.

Julian Kennedy says (p. 458, q. 20):

"The Jones method has made the direct process, which was attended with great dangers and difficulties before the date of his invention, a thoroughly practicable and successful one. Instead of it being a question of great doubt whether to run the metal direct to the converter, or remelt it as it was up to the time of the Jones invention, no one would now think of building a new works, containing both furnaces and converters, without arranging to mix the metal by the Jones method, which not only effects an immense saving in the cost of operating the works, but enables a uniformly good product to be made, and also a purer product than can be obtained from cupola metal, which absorbs and is contaminated by sulphur from the coke which constitutes the fuel of the cupola. * * *

"Jones' invention has solved a difficulty and met a great want which has been felt ever since the invention of the Bessemer process in 1856, and has enabled that process to be used with direct metal as Bessemer first proposed to use it. Bessemer, however, failed in his efforts to overcome the difficulty, and from that time many metallurgists and inventors have sought to solve the problem, but without success, until Jones made the invention in suit."

The utility of the Jones invention is admitted by the defendant's experts. Robert Forsyth says (p. 279):

"The introduction of the mixer certainly made some changes in the direct process practice, and conduced especially to rapidity and regularity of operation."

The practical novelty of the invention is also conceded. Defendant's witness, Joseph Morgan, says (p. 406):

"x-Q. 103. Was not the Carnegie Steel Company the first steel manufacturing concern in this country to install and use for supplying metal to converters a receiving and mixing vessel (other than a ladle receiving metal drawn directly from the runner of the blast furnaces)?

"A. Understanding your question to limit the receiving vessel to direct metal, I believe they were."

See also Mr. Morgan's qualified admission of novelty in answer to x-q. 142, p. 413.

And in the published literature the invention has received marked recognition. In a paper put in evidence by the defendant, giving an account of the proceedings of a meeting of the British Iron and Steel Institute in 1891 (Rec., p. 852), Joseph Massenez, a German steel-maker, Mr. Lauder and Sir Lowthian Bell speak of the Jones mixer as having cured the evils of the direct process; and in the Annual Report of the Commissioner of Patents to Congress in 1896

(Rec., pp. 864, 868), the Commissioner cites the Jones patent as one of the "typical patents which illustrate the various stages of growth in the different arts."

Mr. William Metcalf, speaking of the position of the Jones process in the art, says (p. 622, para. 2):

> "It practically eliminated all of these [prior] troubles, and gave to the world a great advance in the art of manufacturing Bessemer steel."

In determining the patentability of the Jones invention, the statements of these witnesses, all of whom are eminent in their profession, should, we submit, be given very great weight. The improvement has been effected in their own business. They are, therefore, the best fitted to estimate its value and importance. Many of them—Mr. Fry, Mr. Kennedy, Mr. Metcalf and Mr. Sherrerd—have no interest in the invention, or in the complainant company.

INFRINGEMENT.

The defendant's mixing apparatus was built in the fall of 1895 under the direction of defendant's mechanical engineer, Joseph Morgan, and was used prior to the filing of the bill of complaint (Morgan, p. 393, x-q. 41). Before building it Mr. Morgan had familiarized himself with the Jones patent and the Jones process, and for that purpose had visited complainant's works at Braddock, inspected the mixer in operation there, and had asked and obtained Mr. Gayley's opinion as to the most desirable size and location for such apparatus. This opinion he followed in the subsequent construction of defendant's mixer, for he made it of the identical size which Mr. Gayley recommended (Morgan, pp. 391-392; Gayley, p. 553, q. 211, pp. 554-555, qs. 219-222).

Defendant's apparatus is illustrated by blue print drawings described by Mr. Gayley (pp. 32-33) and Mr. Upton (pp. 60-64), and reproduced on page 35.

We can imagine the surprise of the defendant when its eye rested upon the only assigned reason for the reversal of the decree of the Circuit Court, viz.: "The defendant's device does not infringe the second claim of the patent in suit." This surprise would spring from its recollection of the fact that infringement was never seriously questioned, the defense being an assault upon the patent itself. The Chief Engineer of the defendant, Mr. Joseph Morgan, Jr., testified (p. 396, xq. 58): "With the exception of additions of cupola metal [immaterial to the process],* I do not know that there is any material difference between our practice and that described in the second claim." All the other testimony was to the same effect, and cannot be more forcibly stated than in the language of the opinion of the Circuit Court, as follows (Rec., p. 710):

> "Has infringement been shown? In this connection, the question of the apparatus employed is of importance only as bearing on its adaptability for the practice of the Jones process, for infringement of process, not apparatus, is charged. Respondent's apparatus consists, since November, 1895, of a large, covered, refractory-lined vessel of about three hundred tons capacity, adapted to be tipped by hydraulic pressure, having a receiving hopper at the rear end and a pouring spout at the front. Both a blast-furnace plant and cupola system supply metal for its Bessemer converter plant, the former about two-thirds, the latter one-third, the metal used. It is to be noted that the cupola system continues, since the installation of the reservoir, to deliver its metal by ladle to the converter direct, and not through the reservoir. The metal from the blast furnace enters the receiver in approximately fifteen-ton ladle lots, and is withdrawn in approximately twelve-ton ladle lots. Mr. Joseph Morgan, Jr., Chief Engineer

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*To supplement the blast furnace metal the defendant uses in its converters a portion of cupola-melted metal—about one-third cupola metal and two-thirds blast furnace metal, *but the cupola metal is taken directly to the converters, and does not pass through the mixer.* Being of a substantially definite character, it does not need to be mixed (Fry, p. 495, qs. 16-18).

of the respondent company, states that 'in accordance with the natural way of using a reservoir, it is ordinarily kept well-filled up.' [Rec., p. 639, q. 180]. The minimum amount maintained in respondent's reservoir is proved by Mr. Levi T. Upton, as follows [Rec., p. 62, q. 21]:

"Q. Did you see any mark upon the mixer, and if so, was your attention called to it in any way?

A. My attention was called to a chalk mark, which, by the way, I had noticed before, on the side of the mixer. They told me they didn't allow them to run that chalk mark below the floor. When it came to the floor they still had retained in the mixer about 175 tons.

Q. Please state what you mean by the chalk mark coming to the floor.

A. What they call the mixer floor, is where the men work to rotate or tilt the mixer, and if the mark they have on the mixer goes on the floor out of sight, they cannot tell how much they have left.

Q. Am I to understand you that the mixer was not to be tilted more than enough to bring the chalk mark on a level with the mixer floor?

A. That is the meaning I wish to convey, and if they hadn't enough to make out their heat without going below the floor, they wait until they get more in.

Q. Who explained this to you?

A. The Superintendent of the Bessemer department.

Q. What is his name?

A. F. G. Parker.

Q. I understand, then, if the chalk mark did not go below the level of the mixer floor there would be 175 tons of metal retained in the mixer. Is this correct?

A. Yes, sir."

Mr. Parker was not called to dispute this statement.

Mr. John E. Fry, an experienced theoretical and practical steel maker, testifies to the operative process, as follows [Rec., p. 494, q. 15]:

"On Monday, March 29, 1897, I saw the metal mixer used at the Cambria Iron Works. Its principle of construction is similar to the Jones mixer, and its operation is identical with that set forth in Jones' patent.

"When I saw it in use it contained a relatively large body of molten metal which had been brought to it from the blast furnaces while liquid, and relatively small portions of such metal were added to its contents from time to time, and other portions were poured from it into a charging ladle and taken to the converters for conversion into steel. In these operations care was taken to maintain in the mixer a relatively large quantity of metal so that the portions added would remain for a sufficient time subject to the mixing effects of the mixer before being withdrawn. This to 'average up' the chemical constituents of the metal and make the fluctuations gradual as is done in the Jones method.

"Owing to, or in conformity with shop rules, the withdrawals of the converter charges of mixed metals were made with approximate regularity of time intervals, and the additions and withdrawals were made as near 'time about' as possible. The additions were about one-fourth larger than the withdrawals, say five of the latter to four of the former, so that the additions were balanced by the withdrawals.

"An oil-vapor jet was used for heating the empty mixer preparatory to serving it with metal at the beginning of the week's work, but after a quantity of metal was added that was above the established minimum of one-half full, there was no further need for the vapor jet and it was shut off.

"The normal position of the mixer when not in use was upright, and in this position it received the additions of molten blast-furnace metal. In making a withdrawal the mixer was tipped or rocked forward, and it was returned to its normal condition when the withdrawal had been made. A mark was placed on the outside of the mixer so as to move relatively to the motion of the mixer in pouring out metal. There was a chalk mark or white line, and in addition there was a graduated gauge board. The mark was placed relative to a fixed point, so that about one-half the capacity of the mixer would represent the minimum amount of metal desired to be retained for mixing effects.

"It is quite clear, in view of these facts, that infringement takes place. That initial mixing rather than storage is the purpose of the reservoir is shown by the fact that the cupola metal is not stored, but served direct in ladles to the converter plant. And that the homogeneous mixture once obtained is used as a dominant pool to produce a graduated, non-abrupt product, is shown by the chalk-line minimum limit of one hundred and seventy-five tons. With such a permanent dominant pool in constant use, we are clear that respondent's practice infringes the second claim of the Jones patent in both letter and spirit. Indeed, Mr. Morgan himself says: 'With the exception of additions of cupola metal, I do not know that there is any material difference between our practice and that described in the second claim.' The exception noted can have no effect on the question of infringement. In substance, as carried on by respondents, it is a disconnected operation, wholly independent of the mixer. The only exception being where there was not sufficient cupola metal for a full converter charge, the shortage was drawn from the mixer."

"For the reasons stated, we are of opinion that infringement of the second claim is shown."

The defendant's practice satisfies all the requirements of the second claim of the patent in suit. Non-uniform charges of molten pig metal are poured in successive portions into the mixer; portions only of the composite molten contents are removed from time to time without entirely draining or emptying the same; and the mixer is successively replenished with fresh un-uniform additions, all as recited in the claim in question.

In view of the overwhelming evidence above cited, including the admission of the defendant's chief engineer as to the fact of infringement, the conclusion reached by the Circuit Court of Appeals that the defendant did not infringe is seemingly inexplicable. It is not predicated upon the testimony of any single witness, it is not a conviction produced by any serious argument. It has its foundation, however, incorporated in full in the opinion of the Circuit Court of Appeals, and it is a bed of sand. It is a so-called "stipulation" entered into between counsel "showing the manner in which the defendants use what is alleged to be the infringing device."

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This stipulation (p. 64) contains a statement, "that the amount of molten metal in said mixer varies from nothing to its full capacity;" in relation to which the Circuit Court of Appeals finds (p. 1121, para. 3), "It is stipulated that the amount of molten metal ordinarily kept in the reservoir is more than one-half its capacity, but that it varies from nothing to its full capacity, depending on the supply and demand. Doubtless under the ordinary conditions there is a mixing of the molten metal when the partially filled vessel is replenished, but it is only such mixing as is incidental to the pouring together of mixible liquids under the well known principle of diffusion."

It was error, we claim, on the part of the Court of Appeals to predicate its opinion as to the fact of infringement upon this alleged stipulation rather than upon the uncontradicted evidence in the case, and for this reason:— The stipulation as to that question was repudiated.

The history of this alleged stipulation may be found on page 64 of the Record. It was a stipulation made, as will there appear, for the convenience of defendant's counsel. It was made while a witness was upon the stand, called by the complainant to prove the use by the defendant of complainant's process. It was a statement by defendant's counsel of facts peculiarly within the knowledge of his own clients, having relation to their own operations. It contained the language made the corner-stone of the opinion of the Court of Appeals, namely, that the variation in the quantity of molten metal in the mixer was from nothing to its full capacity, depending upon supply and demand.

It subsequently coming to the knowledge of complainant's counsel that in this vital respect defendant's counsel had made a mistake, and that defendant's practice was in fact to constantly maintain the dominating pool, complainant at once, and upon the record, repudiated the binding effect of the stipulation, as will appear upon pages 422-423 of the Record, in these words:

> By complainant's counsel: "It appearing from the testimony of the witness, Joseph Morgan, Jr., [Defendant's Chief Engineer] that the information given by the defendant and embodied in the stipulation printed on pages 97-98 [p. 64] of the Record is in some respects at variance from the facts as explained by Mr. Morgan in his deposition, complainant's counsel hereby notifies defendant's counsel that in so far as the said variance appears, the said stipulation will not be used by him at the hearing."

Being pressed by defendant's counsel to state the variance, complainant placed upon the record the following (p. 423): Complainant's counsel stated "that the said stipulation or admission in its statement 'that the amount of molten metal in the mixer varies from nothing to its full capacity" to be that portion of the stipulation which was at variance with the facts. Whereupon, in view of the complainant's objection, defendant's counsel recalled Mr. Morgan upon the question at issue alleged to have been covered by the stipulation, namely, the practice as to the quantity of metal kept in the mixer, and the witness replied (bottom of p. 423): "I believe our practice is to keep the reservoir well filled up," thus maintaining the dominating pool, the minimum quantity of which, in defendant's practice, as heretofore stated, was about 175 tons.

The legal question involved in all this is, may a stipulation as to facts peculiarly with the knowledge of one party be held to be binding upon the other who, upon discovery of a mistake, promptly repudiates it, especially where the other party subsequently calls witnesses to testify as to the disputed point?

If this Court answers the question negatively, then it sweeps away the foundation of the judgment of the Circuit Court of Appeals.

THE PRIOR STATE OF THE ART.

Among those who have been called by the defendant to compare the Jones invention with the prior practices, there is no one who has ever been in direct charge of blast-furnace work, or who has been engaged as a converter-man—a blower or scrapper—in the refining of metal taken from a Jones mixer. Such omission constitutes a serious defect in the defendant's proofs.

Before Jones' invention, two plans were proposed by steel manufacturers for using direct metal. Neither plan was ever put into successful practice. The first involved the crude idea that diverse lots of metal could be made more uniform by mixing them together. Such simple mixing, whenever tried, has been found to be inefficient. Secondly, some manufacturers, recognizing apparently the inefficiency of a simple process of mixing, suggested the treating of the metal in such manner as to vary its chemical character and its physical condition, superheating it to increase its sensible temperature or adding silicious alloys in order to vary the proportion of its heat-giving constituents. All of the prior patents and publications which have been put in evidence by the defendant and which relate to the manufacture of steel, will group themselves under one or the other of these two divisions.

The Patents of Lohage and Tabberner.

The purpose of the patent of Lohage, No. 55,442, dated June 5, 1866 (p. 895), was the treatment of steel after it has been refined in the converter. The molten refined steel is poured through a red-hot funnel into a furnace where it is over-melted or superheated. It is then withdrawn into a receiving ladle and is cast. Nothing is said about the mixing of metals, nor the preparation of metal for further treatment or refining.

The British Patent of Tabberner, No. 2061 of 1856 (Rec. p. 963), describes a visionary process which consists in using, instead of a large blast furnace, a number of small furnaces whose conjoint capacity is equal to a single large furnace and which discharge into a common hearth. There was no purpose of mixing, nothing except a desire to avoid the necessity of using a single large furnace. The project is of questionable utility, and its analogy to the Jones patent is of the remotest character. Tabberner's invention has no relation to any further treatment or refining. He makes no mention of converters or refining furnaces, and, as pointed out in the opinion of Judge Buffington, page 695, his patent practically antedated the Bessemer process.

The Patent of Deighton.

The British Patent of Deighton, No. 3672 of 1873, (p. 982) is considered on pages 690-693 of the opinion of Judge Buffington, and is mentioned by the Court of Appeals on page 1122.

This patent involves no higher conception than mixing together the entire casts of two or more blast furnaces, in order to get a more uniform batch. The relevant parts of the specification are in the paragraph beginning on the last line of p. 984, and the second paragraph on p. 986, and the sixth claim on p. 987.

Molten metal from the blast furnace runs through long troughs to an open-top tank *m* mounted upon a weighing machine and having at its base a tap hole provided with a swiveled spout through which the metal can be tapped into the converter. The quantity drawn for each charge is indicated by the weighing machine. The sixth claim is:

> "Sixthly. The system or mode of arranging and working Bessemer converters with a receiver or receptacle *m* for mixing the molten metal from two or more smelting furnaces to get a more uniform quality of metal, substantially as hereinbefore described and illustrated in the drawings."

To a person who had never heard of the Jones invention, this patent would suggest only a general scheme of averaging blast-furnace metal by tapping the contents of several furnaces simultaneously* (Gayley, p. 542, q. 175; Metcalf, p. 642, q. 107-9) into a common vessel, mixing them into a batch, drawing it out as needed into the converters, making another batch when the first is exhausted, and so on. But making successive batches is not the method of Jones' second claim; it employs no constant body of metal from which charges are taken and to which corresponding additions are successively made. It would not produce gradual changes in the character of the blows, for the successive batches might be radically different from each other in chemical composition, and they certainly would be very different from each other in actual temperature or sensible heat. The blower would not be enabled to judge from each blow the character of the succeeding one, and the advantages of the Jones invention would not be afforded. The lack of uniformity in sensible heat which such apparatus would afford would be a matter of very serious moment. See the testimony on this point cited below on pages 108-109 of this brief.

And this evil would be aggravated in the use of the Deighton apparatus which is a simple open tank (Kennedy, pp. 446, para. 2; p. 448, q.5).

Deighton's description fails to give any hint of the conclusion at which Captain Jones arrived—that mere mixing is inefficient—that it is idle to seek constancy of composition of the converter charges, and that the secret of success lies in so conducting the process that, in the language of the patent, he may "cause the fluctuation in the quality of the successive tappings to be very gradual," and so that "any sudden variation in the quality of the metal supplied to the converter is avoided."

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*The repeated assertion of defendant's brief, that the blast furnaces would naturally be tapped in rotation and not simultaneously, is in conflict with the proofs. Other things being equal, a group of blast furnaces, like a group of cupolas, are tapped nearly simultaneously. The exception is where ladles are filled and used separately in the practice of the direct process without any mixer. Defendant cites the exception as if it were the rule (Gayley, p. 543, q. 176; p. 642, qs. 107-109).

Jones whole invention consists in a peculiar method of mixing molten metal. To anticipate his claim requires that the prior description should contain a description of that very method. No such description is to be found in the Deighton patent.

But, in order to make the Deighton Patent hit the second claim of the Jones Patent in suit, the defendant tries to supplement the specification argumentatively by the suggestion that the natural way to use the Deighton apparatus would be to keep it full and otherwise follow the description of Jones' second claim. Such method of anticipating a patent is generally unreliable, and is repugnant to the rule that anticipations must be proved and are not to be presumed, that every reasonable doubt must be resolved against the party setting them up (*Cantrell vs. Wallick*, 117 U. S., 694). It involves mere speculation in a matter in which proof and not speculation is required. A prior patentee must be presumed to have understood best his own process, and it is unsafe to add to or subtract from his description. Deighton certainly does not describe any such use of his apparatus as that which the defendant imputes to it; no one before this suit is shown ever to have thought that he did so describe it; and the proofs show, not only that the mode of using Deighton's apparatus suggested by the defendant would not have been obvious to a person who had never heard of the Jones method, but that it is a mode of use of which the Deighton apparatus is inherently incapable. The proof on this subject is concisely stated in the testimony of James Gayley (pp. 542-543, p. 579, q. 344; p. 582, q. 353), to which we refer as part of this brief, and Mr. Gayley's statements are confirmed by Julian Kennedy (pp. 448-450, q. 5) and William Metcalf (pp. 640-642).

Mr. Gayley, in his answer to q. 181, page 544, states that when the Jones mixing apparatus was first erected, the mill superintendents in the absence of Captain Jones, and following their own ideas as to the proper way in which it should be worked, prepared to operate it on the fill-and-empty plan.

This testimony, which is quoted on another point on page 705 of the opinion of the Court below, indicates persuasively that the natural way for a steel worker to have operated such apparatus as that of Deighton would have been to drain it after the mixing of each batch, and not to operate it in the way described in the patent in suit. And the proof afforded by this incident is corroborated by the fact that whenever, prior to Jones' invention, experimenters stated any of the details of their proposed schemes of mixing, they were described as operations in which the receiving ladle was alternately filled and drained. This was notably the case in the descriptions of the proposed schemes of Bessemer. Snelus and Witherow.

The patent of Deighton was historically a failure. It was allowed to lapse for non-payment of the first Government tax (Rec. p. 556). It had nothing to do with the development of the Jones process. It made no impression on the art or on the literature of the art. It is significant, also, as shown in the preamble of the patent, that Deighton was a roll-turner of Workington, England, the home of the Moss Bay Company, of whom Mr. Snelus, in 1878, said (Rec., p. 229):

> "The Moss Bay Company attempted to modify the thing [the intermediate American ladle] some time ago, and put up a heating furnace, but that to his mind was a step in the wrong direction. Anyhow, the thing had failed, and no one in England, as far as he knew, was using any intermediate receiver between the blast furnaces and the converters."

Defendant's experts do not agree in estimating the capacity of Deighton's receiving vessel. Durfee fixes it at 103 gross tons (Rec., p. 214); Forsyth, at 200 net tons (p. 268); Hunt, at 140 tons (p. 295); Morgan, at over 100 tons (p. 369). The dimensions are uncertain; there is no presumption that the drawings are made to a scale, and the mounting of the vessel on a weighing machine in like manner as cupola ladles are mounted on scales, would indicate that it was intended to be of small capacity relative to the charges. The statement that "when the vessel *m* requires repair it is replaced by another kept ready for use" indicates the same thing, as also does the fact that it has an open top, like the ordinary steel ladle.

Defendant has attempted to prove the operativeness of Deighton's method by constructing at defendant's works an experimental covered tank of 70 tons capacity, in which metal from blast furnaces was mixed and prepared for conversion. But the method of mixing which defendant employed in these experiments was not Deighton's method. The metal was carried from the blast furnaces in ladles and poured into the tank in successive portions; and from time to time converter charges were withdrawn and were replaced by fresh additions. A constant pool of metal was maintained in the receiver, and important changes were made in the apparatus; the tank was fitted with a cover; it was not left open, as in the Deighton patent, and the metal, instead of being delivered through troughs, was supplied by ladles (Gayley, Rec., pp. 543, 544; p. 562, x-qs., 259, 260). Even as so modified, the operation was unsatisfactory (Morgan, p. 409, x-qs. 123, 124; Camp, p. 600, qs. 11-14). Although the Deighton experiment was made for the purposes of this suit, no notice of it was given to complainant or its counsel. The testimony was duly objected to on this ground (p. 342).†

The Patents and Letter of Z. S. Durfee.

In 1871 and 1872 Zoheth S. Durfee, an American engineer, obtained two American patents and one British patent for means intended to remedy the evils of the direct process, and in 1874 he wrote a communication published in "London Engineering" (Rec., p. 791) on the same subject. His patents and publication exemplify the second class of suggested plans mentioned above on page 42 of this brief.

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† Defendant has misunderstood the testimony of complainant's witness, in which defendant's attempt to repeat Deighton's process is criticised on the ground that a covered vessel and troughs were used. The facts are concisely stated by Gayley, p. 562, q. 260, and p. 543, qs. 177-8, to whose testimony we refer. The point is this—Deighton's showing of the uncovered vessel, and troughs for leading the metal thereinto directly from the blast furnaces, proves that Jones' process was not contemplated. With no cover and with troughs, the conditions are favorable to a fill-and-empty operation, but they make the Jones process incapable of practice.

Durfee's American patents are No. 118,597, dated August 29, 1871, and No. 122,312, dated January 2, 1872.

In Patent No. 118,597 (Rec. p. 903) Durfee proposes to obtain from blast furnaces, without remelting, a metal product suitable for making castings, by using a reverberatory gas furnace, such as the Siemens regenerative gas furnace, or any similar furnace in which a high heat may be maintained at a small cost of fuel. The blast furnace metal is poured into such furnace and is there "treated in any desired way to refine it, and any metals or alloys of metal can be added at will. The iron in the gas furnace can thus be kept at any given standard," and the metal used for making castings. The process is one of modifying and standardizing the metal by additions of alloys or by partial refining.

The second patent of Durfee, No. 122,312 (p. 909) relates to the treatment of molten pig metal preparatory to its refining in the Bessemer process. After reciting the evils of the direct process and its abandonment at some works, Durfee proposes practically the same process of standardizing, which is described in his earlier patent. He uses a reverberatory gas furnace, into which the crude iron from the blast furnaces is poured, and in which it is mixed with other irons and so treated as to insure uniformity. Pig-iron, metals, metalloids or fluxes can be added and mixed with the metal as may be necessary to bring it to the required character, or where the metal is lacking in carbon and silicon, such lack of heat-giving elements can be compensated by superheating it in the hearth of the furnace. The "mixing" with other iron means doctoring the metal by adding such selected irons or alloys as in connection with superheating will produce a product of predetermined and desired character. Durfee's claims 1 and 4 (p. 910-911) are:

"1. Combining converting vessels with reverberatory furnaces and blast or smelting furnaces in such wise as that the crude iron can be tapped and run or carried, raised and poured from the blast furnaces into the reverberatory furnaces, and then, after being treated as may be desired, be tapped out and run into converters, substantially as and for the purposes described and specified."

"4. I claim the plan herein described of increasing the heat of metals to be converted by the pneumatic or Bessemer process."

Durfee's British Patent No. 685 of 1872 (p. 976), combines the specifications of both his American patents. The first part of the British complete specification (pp. 977-978), is a substantial copy of the second American patent No. 122,312; the latter part of the British specification, is a substantial copy of the first American patent No. 118,597.

Durfee's letter of 1874 to "Engineering" restates the process described in his patents. He says in that letter (p. 791) that his gas reverberatory furnace is intended to receive the crude blast furnace metal which when in the furnace is to be "alloyed or treated as desired;" and again, that the metal can be "alloyed and mixed at will." The nature of the mixing, alloying or treatment is described in the second paragraph on page 792, where Durfee says that if the iron is too low in carbon or silicon "gray or silicious pig can be melted down with it to produce the desired standard," and that, because of the facility for obtaining high temperature afforded by a reverberatory furnace, such metal can be so highly heated in the furnace as to overcome all the difficulties usually met with irons which work cold.

Durfee's plan is essentially different in its principle from the method of Jones. It does not involve the method of making the fluctuations of character in a series of converter charges gradual, by proceeding without regard to the maintenance of any fixed standard, as in the method of Jones' second claim; but, acting on a quite different principle, Durfee proposes to treat or doctor the varying charges introduced into his furnace so as to alter their chemical composition or to increase their sensible heat, and thus to bring them to a standard character, testing the metal in the furnace when necessary in order to determine its condition (Patent No. 122,312, p. 910, line 25). If such method were practicable, which is a matter of doubt in view of the evidence, it would at least be subject to many serious objections. The cost of treating the iron in a reverberatory furnace would be greater even than the cost of casting the metal into pigs and remelting it in cupolas. The furnace also would exert upon the metal bath the same desiliconizing and decarburizing effect which takes place in an open hearth, and thus, by altering the character of the metal, and depriving it of the constituents which serve as fuel during the process of conversion, would render it less suitable for conversion. Durfee himself recognized that this would be the effect of a reverberatory gas furnace (793, para. 7), and he proposed to counteract such evil by superheating the iron. But Mr. Metcalf says that the evil is hardly remediable, at least not without great cost and the employment of a class of workmen as highly skilled as the operators of an open-hearth steel furnace; and he tells of his own experience in using a gas furnace for smelting iron for converters, which like the experience of Siemens mentioned by Durfee on page 793, para. 7, was very unsatisfactory (Metcalf, pp. 630, 631, qs. 26, 27). So rapid was the change in character of the iron which took place in the gas furnace used for supplying the metal for the puddling department of Mr. Metcalf's works, that "nature-iron" balls of partly desiliconized and decarburized metal would form on the bottom of the furnace, and had to be removed. In some cases the furnace became so filled up with such iron in masses weighing from 15 to 20 tons, that it had to be torn down. Mr. Metcalf says (p. 654):

"In the Bessemer department the first difficulty [that of managing the tapping hole] was just as conspicuous and troublesome as in the puddling department. The second was not quite so much so, but we had a third troublesome difficulty to overcome in the fact that we were liable to burn out the silicon and carbon to such an extent that the metal would not blow properly. This trouble caused us a number of serious skullings up before we got our men trained to handle the furnace so as to desiliconize and decarbonize the iron. We found in both departments that we required men of about as much skill as are required in handling an open-hearth steel plant."

"(P. 657, q. 207.) The continuous holding of iron in a furnace from morning to night was extremely difficult, hazardous and expensive, and I look on it now as a horrid nightmare."

Mr. Kennedy says (p. 451):

It would be very expensive to treat the metal in an open hearth or reverberatory furnace. The heating of the metal in such manner would burn out the silicon, and the process would therefore be inefficient and uneconomical."

See also Fry, p. 491, q. 9.

The nature of a reverberatory furnace, which is illustrated in the drawing on page 827, negatives the idea that it could be operated like a Jones mixer.

So much for the impracticability of Durfee's suggestion. If it had been put into practice, it would have failed to meet the difficulties of the direct process, and in point of cost it would have been worse than the cupola practice. Its effect upon the metal would have been positively hurtful. It was a mere suggestion, abandoned as a confessed failure when it was tried at Moss Bay (p. 789, line 10 from bottom). The British patent was allowed to lapse for non-payment of the Government tax (p. 555), and the invention has contributed nothing to the art.

Jones' apparatus is not a reverberatory furnace.

Defendant's expert witnesses attempt to establish an analogy between Durfee's patent and the patent in suit, by arguing that the Jones mixer is in effect a reverberatory furnace, because the Jones patent states that heat may be "kept up" if necessary or found desirable by burning gas introduced by a pipe into its interior. But this argument is a mere play upon words. It is answered forcibly in the testimony of Julian Kennedy (pp. 450-1, q. 7), James Gayley (p. 43, x-qs. 88-92), and William Metcalf (p. 631, q. 28).

The attempt to make a reverberatory furnace of the defendant's mixer at Johnstown is also groundless, and the drawings exhibited by the defendant, showing the interior of its mixer filled with a large volume of flame, are incorrect and misleading. Morgan admits that the gas-pipe of the defendant's mixer is used for heating the long protruding spout or nose of the vessel and to prevent it from skulling (p. 410, x-q. 130); and in the testimony of Fry the defendant's burner is described as follows (p. 494):

> "An oil vapor-jet was used for heating the empty mixer preparatory to serving it with metal at the beginning of the week's work, but after a quantity of metal was added that was above the established minimum of one-half full, there was no further need for the vapor jet, and it was shut off."

On the other hand, there can be no doubt as to the character of Durfee's furnace. It was to be a furnace capable of generating high heat and of melting pig metal—a reverberatory furnace of ordinary type (see Holley's paper, Rec., p. 842, para. 4, and Durfee's patent No. 114,277, Rec., p. 862, to which reference is made in Durfee's patent No. 118,587, p. 903, para. 5; Kennedy, pp. 473-4, qs. 110, 111). Mr. Kennedy's testimony last quoted should be read in connection with his cross-examination on page 466.

The Patents of Witherow.

Two patents granted to J. P. Witherow have been put in evidence by the defendants, and have been discussed at some length by their witnesses—Patent No. 315,587, dated April 14, 1885, and Patent No. 327,425, dated September 29, 1885. They are considered on pages 693-5 of the opinion of the Court below, and in the opinion of the Court of Appeals, pp. 1119, 1120, 1122.

In the first patent No. 315,587 (p. 941) Witherow proposes to deal with the direct process, and speaks of its successful use as a thing substantially new, at least new enough to constitute the purpose for which his patent was granted. He says (941, para. 2) that the purpose of his invention is to "make the production of steel from the ore a continuous operation in a single plant." This is a sufficient indication that, at least until 1885, no means had come to the knowledge of Witherow adequate to obtain successfully that result.

Witherow proposes to tap the molten metal from the blast furnace into a receptacle (p. 942, line 13) "preferably constructed to take the whole amount of a cast from the blast furnace, but may be made for or used with a smaller quantity." In para. 3, p. 942, he indicates that the vessel is to be used as an intermediate distributing reservoir to avoid the necessity of frequently tapping the furnace. As the vessel is adapted to hold only a single cast, and therefore must necessarily be emptied before another cast is tapped into it, it is impossible that Witherow intended by its use to practice the method of Jones' second claim. And this of itself is a sufficient answer to the argument by which the defendant seeks to supplement the Deighton patent by arguing that the natural way to use it would be according to the Jones method. Witherow, with all the experience which defendant's witness Hunt attributes to him (p. 303, q. 69), did not find this to be the natural method, and the presumption is strong that if Deighton had put his method into practice he would have done substantially what Witherow purposed to do, namely—drain the vessel before refilling it.

Witherow's second patent, No. 327,425 (p. 944), adds nothing, in respect of mixing, to his earlier patent. He states (para. 2) that the metal is usually tapped from a blast furnace once every six hours, in a quantity many times in excess of a converter charge, that economy of manufacture forbids more frequent casting and particularly the casting of the comparatively small quantity necessary for a converter charge, and that in order to supply molten blast-furnace metal to the converters, as it is needed, he would tap it into an intermediate receptacle (p. 945, line 1) of sufficient size to hold the entire cast of the furnace. He proposed to prevent the metal in the receptacle from losing heat, by blowing an air blast upon its surface so as to oxidize it and produce a floating silicious slag. This patent is subject to the same criticisms as Witherow's earlier patent, and, like it, throws a strong side light upon the proper interpretation to be given to the specification of Deighton.

The Witherow patents have been discussed intelligently in the testimony of Kennedy (pp. 451-2, q. 8), to which we refer.

The Terre Noire Practice.

In the steel works at Terre Noire, in France, where direct metal was used in the converters, it was the practice to draw half the contents of the converter-charging ladle at one furnace, then to fill it at another furnace, the purpose being to obtain a better mixture of iron. This is described in the "Journal of the Iron and Steel Institute" for 1871 and 1874 (Rec., pp. 750 and 755); and a like practice is described at page 785 and page 806, last para., and in Mr. Holley's paper (p. 835).

The Terre Noire practice lacks the controlling principles of Jones' invention. The definition of the second claim does not apply to it; nor is it described, as defendant contends, by the language of the Jones specification in the first 7 lines of para. 3, p. 872, an essential characteristic of which is the mixing together of portions of metal previously collected in several ladles and thence poured in small lots into a common charging ladle. The Terre Noire practice was an expedient of the simplest kind, which was resorted to by furnace managers with the hope of bettering the metal. Wherever tried it proved unsatisfactory. It was employed occasionally by the Carnegie Steel Company when using direct metal at their Edgar Thomson works. Mr. Gayley says (p. 30, last para.), that from its use "no benefits were ever derived," and on pages 539-541, qs. 167-171, he describes the practice in detail and concludes (qs. 167-170): "We observed from it no improvement of the character of the steel. * * * It is entirely different in principle from the Jones method." (See also Kennedy, p. 446). Even at Terre Noire it seems to have proved inefficient. Notwithstanding the greater facility which the manganiferous ores gave that works, in common with other works on the Continent, for using the direct process (Rec., pp. 833, 843-844), Mr. Holley, in his report of 1877, says that the variation in heat of the converter-blows was there also a serious difficulty, and he concludes thus (p. 833):

> "In other words, it has not been practicable to work the blast furnaces with sufficient regularity to realize approximately the theoretical advantage of the direct process."

See p. 844, para. 1, concerning a like experience at Creusot.

The steel works at Terre Noire were shut down permanently in 1889 (Rec., p. 551, q. 204).

THE PRINTED DISCUSSIONS.

The published discussions of the Iron and Steel Institute of Great Britain throw much light upon the history of the art.

On the Continent of Europe, owing to the presence of manganese in the pig metal (p. 833, para. 3), which to some extent corrected the evils caused by variant percentages of silicon, the direct process had been employed at a number of works, and the need for accomplishing the same end in the English works, and thus doing away with the remelting of pig metal in cupolas, was a pressing one. Sir James Ramsden, in the meeting of 1874, said that "to use the fluid pig iron direct in the Bessemer converter, there was no doubt it would be an enormous saving and economy" (p. 754, para. 1). Mr. Snelus estimated such saving at from four to five shillings per ton (p. 780). Addresses were made at these meetings by T. J. Smith, of the Barrow works; E. W. Richards, of Ebbw Vale; Mr. Snelus, Edward Williams, of Bolckow, Vaughan & Co.'s works; Sir James Ramsden, Mr. Menelaus and Sir Henry Bessemer. The remarks of Snelus and Bessemer we will consider separately.

At Barrow, Ebbw Vale and Bolckow, Vaughan & Co.'s, the managers had begun, or were about to begin, to use the direct process. Their hopes and the results of their experiments formed a constant topic of discussion. Although naturally desirous to say nothing in disparagement of their own methods or products, yet throughout the discussions, alternated with expressions of success, appear indications of difficulties more or less clearly confessed. Sir James Ramsden (p. 753) said that at Barrow "the subject had been under the consideration of the Barrow Company for some time; in fact they had tried some practical experiments, and had arrived at the conclusion that, as far as their knowledge went, it was a very doubtful undertaking. Certainly they could not produce the quality of steel that was necessary to satisfy the market at that time."

Mr. Schneider (p. 754) said that the—

> "whole reputation of the Barrow works consisted in the quality of its manufacture. It was not known, and had never yet been found that they could have even the whole of one cast of the same quality, and if they were to go on from day to day running in the molten metal, the result would be that they would have accidents with steel rails in the same way that they had accidents with iron rails; the fact was that the steel rails would then be absolutely valueless."

Mr. Williams, an advocate of the direct process, dissented from the remarks of Messrs. Ramsden and Schneider, and J. T. Smith predicted that the direct process might be used successfully, provided they could employ sufficiently great care in working and filling the blast furnaces (p. 758)—

> "which, he was bound to say, he did not at present see his way to obtain. * * * They would be exceedingly glad if Mr. Williams would pioneer them out of that difficulty of remelting, * * * but he did not see how it was possible at Barrow, unless they had a marvelous improvement, not only in their workmen but in themselves."

Mr. Whitwell (p. 760) said, with reference to the use of the direct process on the Continent, that he had been particularly struck with the extreme care they used in selecting the ores for the blast furnace,—

> "taking a certain exact weight and percentage of the most carefully selected quality of ore, and this enabled them to obtain that regularity from the furnace which was indispensable for the direct steel process. He imagined and believed that that was in a great degree the cause of the good results that Mr. Williams had obtained."

Mr. Whitwell's statement in the sentence last quoted was confirmed by J. T. Smith at the meeting of 1876 (p. 775, and p. 787), where he attributed the success which he had experienced to the great care which he had to exercise in managing his blast furnaces.*

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*On p. 787, it is said: "Mr. Smith maintained still what he stated on the previous occasion with regard to steel works arranged with blast furnaces, that one of the great advantages of that process was the regularity they were obliged to have with respect to the blast furnace operations because so sensitive was the Bessemer converter—at any rate in the case of the iron they made—that with a very small alteration in the proportions of the various classes of hematite ore, the difference in the steel produced from the converter instead of being about 14 per cent., was found running up occasionally to even 30 per cent., so that the moment such a result occurred, they went to the blast furnace management for an explanation of the waste, and he was bound to reiterate that he considered the main saving they had in conducting their operations in Bessemer steel making really was because they were managing their blast furnace better than they had been before."

In the meeting of 1875, Mr. Menelaus, the president, referring to the purpose of Edward Williams to use the direct process at Bolckow, Vaughan & Company's works, predicted that Bessemer steel would be made in this way with considerable economy, but he adds (p. 762):

"I am speaking, of course, of the manufacture of Bessemer steel for ordinary purposes. Where a very special quality is required, it may be necessary to select the pig iron as we do now, and to remelt it; but this will be a matter of experience."

The remarks at the meetings of 1875 and 1876 were more hopeful than at the meeting of 1874, but J. T. Smith, on page 776, after speaking of the great care necessary to be exercised in their blast furnace practice when using the direct process, said:

"With respect to the economy of the process, they were not in a position, except roughly, to estimate that there was such a saving in the production of steel as to make it worth while their continuing the arrangement."

E. Windsor Richards (p. 777) reported success in the use of the direct process at Ebbw-Vale, but he added, significantly, that "in working in this manner, of course, a much greater degree of attention was required in selecting the coke and ores, and in the careful weighing of materials into the blast furnaces;" and this statement was confirmed by Mr. Snelus, who, on page 779, said: "Of course he agreed with all that had been said about the necessity of keeping the furnace working regularly."

Mr. Sharp (p. 780) said that, as a Bessemer steel maker, he had—

"found that all the iron they bought varied very much in quality, and that, to his mind, had always been the great obstacle to running the metal direct from the blast furnace into the converter, particularly where they wished to have steel of a high and uniform quality."

Bessemer's Plan of 1876.

In the "Journal of the Iron and Steel Institute" for 1876 (Rec., pp. 781-783), Sir Henry Bessemer gives an account of his early work. He says that "his fine-spun theory that all kinds of iron would answer the purpose was knocked on the head in an instant, and that it took him something like two years to recover from the blow," and that finally he procured a special pig iron to be made for him for use in the Bessemer process. He then describes a plan of mixing which he had proposed to some friends several years before, but which seems never to have gone into use. The plan suggested (bottom p. 782) involved the construction of one or two closed spherical vessels of 20 tons capacity, each adapted to receive three 7-ton furnace tappings, and to carry the metal to the converters, where the four 5-ton converter charges were to be drawn off in succession. Bessemer said (p. 782):

> "It was proposed to make at least three 7-ton tappings into that [20-ton] vessel, and to move it on wheels into the converting house, using a pair of converting vessels, one after the other, until the four charges of five tons each were worked off."

Here is a clear description of an alternate charging and emptying of the vessel; it would result necessarily in sudden fluctuations of composition and temperature of the metal, and the suddenness of the changes would render the operations of the converter uncontrollable. It is unlike Jones' plan, but is analogous to that of Witherow's patents, and is of importance as showing that Sir Henry Bessemer, the then greatest living metallurgist and the founder of the art which bears his name, as the result of careful study and full appreciation of the difficulties of the direct process, arrived only at a method of filling and emptying, and distinctly failed to suggest the invention of Jones. How, then, can it be said, where Bessemer failed to discover the Jones method, that it was, nevertheless, so obvious that any one would have seen and practiced it?

Snelus' intermediate ladle.

Defendant's experts have misunderstood the published remarks of Mr. Snelus. For example, on page 369, last para., Mr. Morgan quotes from the Journal of 1874 a brief extract taken from page 757 of the Record, in which Snelus says that the desideratum for direct metal work was an intermediate vessel between the blast furnace and converter—such a vessel as in American cupola practice would hold 10 to 12 tons of iron; and on page 370 Morgan concludes that this suggestion brings us to a practice embodying the method of the Jones patent. But this conclusion is not warranted by the context. Thus, on page 757 Snelus discusses the difficulties of direct working, and states that the plan which he advocates is "rather a radical change." Most chemists, he says, can make a silicon analysis in half an hour, and if, after analysis, the metal from a blast furnace were found to be too silicious, the excess could readily be "toned down" by adding a non-silicious pig, apparently molten pig iron which has been melted in cupola furnace. He says further that it is essential (and this was his plan) to make a pig metal sufficiently silicious to contain enough silicon or possibly an excess of silicon, run it into an intermediate receiver or ladle, where it could be analyzed, and "they could then deal with it as they liked"— *i. e.*, they could make such additions to it as would ensure its proper condition for conversion. "They ought to know the amount of silicon contained in the metal before it was used. That could be regulated."

This is not a description of the Jones method, but is an indefinitely outlined plan along the line of Durfee's furnace, involving the collecting, testing and empirically doctoring or "toning down" the blast furnace metal with suitable additions before delivering it to the converters.

The subsequent history of the direct process at the English works proves that no such process as that of Jones was employed there.

The confident assertions and expressions of hope on the part of the speakers at the meetings of the Institute above noted were made in 1874 to 1876, and it is of importance to note the sequel of their various attempts to use direct metal. The record gives us full information.

In 1878, only two years after the meeting at which the greatest confidence was expressed, we find Mr. Snelus (p. 789, para. 2) confessing that "there were no doubt difficulties in the way of working iron direct from the blast furnace," and that, although he still believed in an intermediate receiver, he had never yet put one up. And in this connection Snelus states (bottom p. 789) that a 30-ton ladle or receiver, such as he had in mind, was about to be provided by Mr. Fritz of the Bethlehem Iron Works, for receiving the metal from the blast furnaces and obtaining a better mixture. But again we find that this plan when carried out did not result in the Jones method, for when Mr. Fritz, of Bethlehem, came to adopt the direct process he used it in its simple form without any mixer, and he has since announced his intention to apply for a license to install the apparatus of the patent in suit (Gayley, p. 583, q. 355). There could be no stronger testimony than this that the vaguely stated plans of these prior publications, however closely they may appear to resemble the Jones method in the light of the ingenious arguments of the defendant's experts, never did disclose it to the men by whom they were originally suggested.

It will be remembered that at the meetings of the Institute the discussions were directed largely to the introduction, or proposed introduction, of the direct process at Barrow, Ebbw-Vale and at Bolckow, Vaughan & Company's works. We have in the record the history of these operations, given partly by complainant's witness David Evans, who has been manager at all of those works (p. 80), and partly by a published statement of Sir Lowthian Bell, who was one of the proprietors of the Barrow works, and whose address, made before the Institute in 1891, has been put in evidence by the defendant (pp. 855-856). These works have now adopted the Jones method under license. Mr. Evans tells of their experience with the direct process before the Jones invention was employed. He says (p. 80):

> "We had great difficulty at Barrow in consequence of the variant qualities of the ores used in the blast furnaces. The pig iron produced varied so much in silicon and other metalloids that we had great difficulty in using direct metal for our steel works. * * * (p. 81). My directors decided to erect a mixer at Barrow and this gave or fulfilled every promise that Captain Jones mentioned and produced for us very much more economical results.
>
> "A. 10. In 1876, when I was manager at Ebbw-Vale, I was one of the first to use direct metal from the blast furnaces to the converters. We experienced there the same difficulty as explained before, that through the variant quality of ores used in the blast furnaces, it was not possible to obtain uniform results, the silicon sometimes being so high that it may take about two tons of scrap in the charge, while other casts from the furnaces would not take any scrap.
>
> "A. 11. (p. 81). The result, as stated before, would be hard or soft rails and, consequently, we should also make more defective rails or seconds.
>
> "A. 16. (p. 82). Prior to the invention of Captain Jones several firms used the direct process, but the results were not very satisfactory, as explained before, through want of uniformity. The results obtained gave a large number of defectives. But since the adoption of the mixer at the various works I have been engaged, we have reduced the defective or second-class rails fully one-half and also saved the remelting."

In Sir Lowthian Bell's address (one of defendant's exhibits) are stated the results which followed the introduction of the Jones process at the Barrow works; and it appears from his account that prior to the adoption of that process, none of the expectations of Messrs. Williams, Smith and Snelus had been realized under the actual conditions of continued experience. We quote from page 855 of the Record:

"Sir Lowthian Bell, F. R. S., said he would like to add his experience at Barrow to that which had fallen from his friend, Mr. Lauder. They had there one of the [Jones] mixers. Of course, it was well known to any one who followed the action of the blast furnaces that, apparently without any cause known to those in charge, there was a considerable variation in the composition of the pig iron obtained. That observation was particularly applicable to the variations in the contents of silicon, which necessarily affected the future operation of the steel-makers. If they had too much silicon, there would be too high a temperature in the converter; and, if they had the silicon too low, they would have too low a temperature. The consequence was an irregularity in the product, causing great waste of iron and an increased quantity of defective rails. He was bound to say that since they had applied the mixer they found a considerable improvement in this respect, but whether it was all due to the mixer he was not prepared to say. The mixer held about 100 tons of iron, and as they ran ten tons out at one end they ran ten tons in at the other, so that practically they would have an average of ten furnaces, or of iron taken at ten different times. Since they had begun to use the mixer the 'defectives,' from whatever cause, had fallen to something like half of what they were before. The expense of working the mixer was little or nothing."

The practice at the Rhymney Works, cited by defendant's witness Morgan (p. 372-3), is also described in the testimony of Mr. Evans, who was manager of those works for many years (Morgan, p. 373; Evans, p. 80), and who says that "the results obtained gave a large number of defectives." (See testimony quoted on page 62 of this brief.) History and the speculations of defendant's expert witnesses are here again at variance.

In summary of these discussions of the British Institute, it is a fair statement that in 1874-1876 the English manufacturers, eager to effect the saving and to get the bettered product which would follow dispensing with the remelting in cupolas, essayed the direct process, some of them supplementing it by simple methods of mixing. At first, with the exercise of great care in working their blast furnaces and in selecting pure and uniform ore and fuel for the furnace charges —expedients which must have entailed expense nearly as great as that which they sought to cure—they believed they had attained success, but later experience proved the contrary. The metal fed to the converters was irregular in composition and temperature, the waste was great, and there was a high percentage of defective rails. All this continued until the introduction of the Jones invention in America; whereupon, and very promptly, these English works, at which all this experimenting had been done, adopted the Jones invention under license, reducing at once "to something like one-half" the proportion of defective rails. This is good evidence that the Jones invention possesses patentable character, and is quite inconsistent with defendant's theory that it was anticipated in substance by these prior expedients which it has since displaced.

The Barbed Wire Patent, 143 U. S., 292, line 1.

HOLLEY'S REPORT OF 1877.

The late Alexander Holley, a metallurgical engineer of great distinction, was employed professionally by the Bessemer steel manufacturers of the United States as an adviser; and an important part of his duties was to keep them informed as to the practice at foreign steel works. It was his habit to visit Europe at least once a year to obtain data for his reports which were printed and distributed among his clients (Rec., p. 300). One of these reports dated June, 1877, is an exhibit in this case, and is entitled "The Direct Use of Blast Furnace Metal in the Bessemer Process," (Rec., p. 832).

The report is especially valuable in this case, because it gives Holley's judgment of the state of the art in 1877. It was written subsequently to and with full knowledge of the publications upon which the defendant now relies. It begins with a statement of the evil to be cured, viz.: That the direct process realizes an economy of about a dollar a ton on rails (p. 833), that "the embarrassing feature of the direct process is the irregularity in the heat—that is to say, in the silicon of the charges"—and that "it has not yet been practicable to work the blast furnace with sufficient regularity to realize approximately the theoretical advantages of the direct process."

On pages 834-838 Holley describes the practice at the West Cumberland Works, managed by Mr. Snelus, and mentions Snelus' intention to try as an experiment the use of a 20-ton ladle on an hydraulic lift for storing, mixing and pouring three six-ton or seven-ton blast-furnace taps, which is shown in para. 5 of page 833 to have been intended to be a mere fill and empty operation. He says (p. 838):

> "Although the results are constantly improving, it is admitted at West Cumberland that the cupola practice is still the best for special steels where great regularity is required."

The "improving" here mentioned seems to have been due to care in the management of the blast furnaces (p. 837, para. 2).

On pages 838-841 the practice at the Barrow works is discussed, and it is stated (p. 840, para, 3), that, "whatever the cause, the silicon is constantly varying as much as one per cent.; that is, from about two to three per cent." At the bottom of pp. 841-842, Holley describes the unfinished Bessemer works at Moss Bay, at which a large 60-ton reverberatory coal-fired furnace or two 40-ton furnaces were intended to be used for heating the metal on the plan described by Z. S. Durfee; and Holley states (p. 842, para 3), "I am promised an early account of the results of this experiment." That the experiment was unsatisfactory and fruitless appears in a paper published in 1878, a year later than Holley's article (line 8 from bottom p. 789) where Snelus calls it a step in the wrong direction.

At the middle of p. 833 Holley states that the obvious remedy for the difficulties of the direct process is to mix a number of blast furnace charges; and (p. 837, last lines of para. 2), mixing is said to be "the theoretical solution of the problem." But Holley nowhere suggests the principle of so mixing as to make gradual the fluctuations in character of the metal, which underlies the second claim of the patent in suit. The two plans for mixing, which (middle of p. 833) he says are on the eve of trial, are: First, "simply mixing so few charges in a tank that the metal will be drawn out before it chills." In this Holley evidently had reference to Snelus' 20-ton ladle, mentioned on page 837 of the report. Second, a plan like that of Z. S. Durfee, "to store a larger number of charges in a heated tank; that is to say, in an immense open-hearth furnace." Neither plan is the method of Jones.

The summary on pages 845-846 is important. It will be remembered that Holley's purpose in rendering the report was to advise his clients confidentially whether it would be profitable for them to undertake the direct process. He concludes—

That in the then state of the art American manufacturers, even those whose works include a considerable blast furnace plant, were not "incurring an important loss by selecting and remelting pigs"; and that if, with all the advantages of better ore-supply and better blast furnaces and greater number of blast furnaces,

> "with a less experimental ore-supply than we have, and with a better average blast furnace-practice than our own (although it may not be better than our best) and with so great a number of furnaces that one or another may be relied on for approximately suitable pig—if with all these advantages the English works are in such serious trouble about silicon that they are devising expensive remedies in the way of mixing furnace products, then it seems reasonable to suppose that we, with our more experimental ores and less refined practice and fewer furnaces, should encounter still more serious embarrassments; and the existing margin of profits, even at West Cumberland, is not large enough to carry more than its present burden."

The need for some successful mode of mixing and the benefit to be expected if it should be developed are pointed out; and Holley adds that if the storage of a large quantity of iron according to the two plans which he had suggested on page 833 should prove successful, then "a few blast furnaces, making even an irregular product, and, if necessary, working in connection with cupolas, would largely economize the Bessemer manufacture." Holley then repeats that mixing on a large scale is the theoretical key to the situation, and that, when the way to its successful adoption is demonstrated, the direct process will undoubtetdly have great advantages; but he continues (p. 846, line 2):

> "Until this large scale mixing is developed, it should not appear that the use of our comparatively irregular blast-furnace metal, and more especially the use of part blast-furnace metal and part cupola metal, can result in any substantial saving."

In the second paragraph on page 846 Holley states that the mixing problem is not "such a difficult one;" but the means of solving it which he immediately suggests—namely a furnace in which a flame is spread over a large surface of metal—is not the process of Jones, but is the plan of Durfee, which was tried and abandoned at Moss Bay.

On page 846, para. 3, Holley expresses congratulations that direct metal users had no advantage over the American manufacturers, all of whom were then using cupola metal; and he points forward to the development of the art as a matter merely of hope.

The whole tenor of Holley's report was a caution to the American manufacturers against the use of direct metal. His counsel was to wait; and while he expressed hope that the development would come, and even pointed out lines along which he expected it to come, it is significant that neither of the two plans which he had in mind proved successful, and that the art did not afterwards advance any further than where he left it until it was developed and perfected by Jones.

Mr. Carnegie gives a correct judgment of the Holley report. When asked on cross-examination (p. 438, x-q. 50) in what respect it failed to describe the Jones invention, he said:

> "It is the difference between a want recognized and the means to meet that want. Mr. Holley was the man who knew that the egg had to be set on end, and Capt. Jones was the man who set the egg on end. That is the difference. If Mr. Holley described Mr. Jones' invention, then, he would have developed the necessary appliances; then there would have remained no problem to solve. That is the broad fact in the case."

The law justly imposes upon the defendant the burden of showing affirmatively, from Holley's paper itself, that the two plans of mixing which he suggested, or either of them, was, in substance, the same as the Jones method. Defendant has not sustained this burden; but, on the contrary, it is capable of proof that no thought of the Jones method was in Holley's mind. The first plan which he suggested was Snelus' plan of mixing a few charges in a single tank, and drawing them out quickly before they should become too cold to work. The second plan of using a large open-hearth furnace was also intended to be worked by alternate draining and charging. There was no thought of keeping the furnace full by withdrawing "portions only" and successively replenishing the receptacle with fresh un-uniform additions, and this is proved to demonstration—

1. Because Holley, as a skillful metallurgist, would have known that, if the operation were made continuous in an open-hearth furnace, his object would be defeated by changes in character of the metal, which would not only deteriorate the metal for purposes of conversion, but would tend to form "nature balls" and thus choke the furnace. See the testimony of Metcalf and Kennedy cited, pages 50-51 of this brief.

2. Because Holley himself states, in effect, that such was the case. On page 846 he says: "A small amount of flame,

spread over a large surface of metal, should certainly keep it hot for a long time." This means that the flame would keep up the heat long enough to enable the draining out of "the larger number of charges" which he intended to use, so that the last charge removed would still be hot enough to be put into the converter.

It must be remembered also that this plan which Holley suggests, and which, page 841-2, he says was about to be tried at Moss Bay, was afterwards tried and was a confessed failure. Snelus says (p. 789) that it was a step in the wrong direction. "Anyhow," he says, "the thing had failed, and no one, so far as he knew, was using any intermediate receiver between the blast furnace and the converters."*

It remained for Jones, cutting loose from all such plans as this, to originate the method of maintaining a number of diverse charges in a mixing vessel, replenishing it and keeping up the heat by fresh additions, making the fluctuations in the composition and temperature of the withdrawals gradual, rendering the operation continuous from hour to hour and from day to day, and dispensing with the need for all extraneous heat other than that afforded by the frequent increments of hot furnace iron, thus eliminating disturbing influences which would tend to change the character of the metal.

There is also in the record an article introduced by the defendant which indicates that Mr. Holley's later judgment was even more adverse to the adequacy of any known method of mixing. Mr. Maynard, on being asked by the president of the British Iron and Steel Institute at the 1878 meeting to make some remarks, said, speaking of the use of direct metal (p. 789, line 6):

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* The trial and failure of this plant at Moss Bay removes it from the case as irrelevant, and with it all that portion of Holley's Report which relates to it, and which seems to be the ground upon which Holley based his hope for the successful development of the mixing problem. In Deering vs. Winona Works, 155 U. S., 286, 302, the Court, in overruling a like defense, say: "His [the prior experimenter's] efforts must be relegated to the class of unsuccessful and abandoned experiments which, as we have repeatedly held, do not affect the validity of a subsequent patent."

"Mr. Holley had of late taken very decided views on that subject, and had quite come to the conclusion that the hoped-for advantages had not resulted altogether, because you had not absolutely in your control to get a more uniform metal from the blast furnace."

The failure of Holley's report to anticipate the Jones method is proved by the subsequent history of the art. The report was widely circulated among steel-makers in America (Forsyth, Rec. p. 273-4; Hunt, p. 300; Morgan, p. 406). The expert witnesses who testify in this case were familiar with its contents, yet it suggested the Jones method to none of them. Julian Kennedy, who has no superior in knowledge of blast-furnace practice and steel manufacture, states that it did not suggest to him any efficient means for using direct metal, although he was vexed with the evils which he was experiencing from its use at the Edgar Thomson furnaces (Rec. pp. 456-9, qs. 16-20). Mr. Carnegie, Mr. Lauder, Mr. Gayley, Mr. Metcalf and Mr. Fry, say that the Jones invention was entirely novel to them.

Prior to the installation of the Jones mixer, Julian Kennedy had a conference with James Gayley, the superintendent of the Edgar Thomson Works, and after consideration of the results of the direct process, as it had been used by the Carnegie Steel Company and others, their joint conclusion was that in the building of new mills it would be better to go to the expense of erecting cupola furnaces rather than to submit to the disadvantages which the use of direct metal entailed. Kennedy says (p 459): "We did not then perceive any means adequate to overcome these disadvantages." As a historical proof that the Jones invention was not an obvious modification of well-known prior practices and publications, this deliberate conclusion then reached by these well-informed engineers is very persuasive.

But more convincing still, because free from every possible bias, is the action of the steel companies, to whom Holley's report was rendered. Although they were familiar with Holley's report, and had every inducement to avail themselves of whatever merit it might contain, yet when they adopted the direct process, they made no attempt to abate its difficulties by any mixing operation, such as that of the Jones patent. The Cambria Iron Company, the Illinois Steel Company, the Bethlehem Iron Company and the Carnegie Steel Company, none of them installed a mixer. If defendant were correct in the contention that the Holley report did contain a working description of the Jones method, the probability is strong enough to amount almost to a certainty that that method would have been adopted by these large and wealthy concerns. The Cambria Iron Company—instead of constructing, as they did, expensive apparatus preparatory to adopting the direct process, and then abandoning it after learning from Mr. Carnegie and Mr. Gayley of the difficulties which had been experienced at the Edgar Thomson Works—would have installed a mixer; and the same thing would have been done at the Vulcan Iron Works, which was designed for using direct metal by Mr. Holley himself, but at which no mixer was ever built (Fry, p. 495, q. 21).

Eleven years elapsed between the date of Holley's report and the first use of Captain Jones' method of mixing.

The published remarks of Mr. Snelus, made after the date of the Jones patent, and put in evidence by the defendant under objection (Rec. 860), in which he commends the Jones mixer, but claims to have thought of a mixing apparatus long ago, although he admits that his plan was rejected and was never put into use, are considered in Judge Buffington's opinion (middle p. 696). The tendency which induces men to belittle the accomplishments of successful inventors by magnifying their own prior and unsuccessful work, makes such remarks as these of Mr. Snelus valueless as proof (*Barbed Wire Patent*, 143 U. S., 275).

The History of Jones' Invention Proves it to be Patentable.

A valuable invention such as that of Jones should not be set aside on the ground that it is a simple invention. The policy of the law is to treat the question of invention as one of fact, and to determine it by what this Court, in *Keystone Manufacturing Company vs. Adams,* 151 U. S., 145, has called "the test of practical success." Any other test will afford results as variant as the habits of thought of the persons applying it. In the present case every consideration points to the patentability of the invention. To argue it to be unpatentable is to disregard the history of the invention, and to stultify not only complainant's witnesses, but the defendant and all other manufacturers of steel who, having this supposedly obvious process at hand for so many years, failed to avail themselves of it.

The matter now seems very simple, and one may wonder why it was that, when Holley came so near to solving the problem, he stopped short of success. But such cases are frequent. In The Barbed Wire Patent, 143 U. S., 275, the invention was a fencing, comprising a pointed wire barb coiled about one of the fence wires and held in place by twisting the other wire around it. It was old to arrange similarly on two wires a diamond-shaped metal barb. This Court said (pp. 282-283):

> "In the law of patents it is the last step that wins. It may be strange that, considering the important results obtained by Kelly in his patent, it did not occur to him to substitute a coiled wire in place of the diamond-shaped prong, but evidently it did not; and to the man to whom it did ought not to be denied the quality of inventor. There are many instances in the reported decisions of this Court where a monopoly has been sustained in favor of the last of a series of inventors, all of whom were groping to attain a certain result, which only the last one of the number seemed able to grasp."

In Vickers vs. Sidell, Law Reports, H. L., 1890, Vol. 15, page 502, the House of Lords, by Lord Herschell, said:

> "If the apparatus be valuable by reason of its simplicity, there is a danger of being led by that very simplicity into the belief that no invention was needed to produce it. But ex-

perience has shown that not a few inventions, some of which have revolutionized the industries of this country, have been so simple in character that, when once they were made known, it was difficult to understand how the idea had been so long in presenting itself, or not to believe that they must have been obvious to every one."

In *Webster Loom Company vs. Higgins*, 105 U. S., 580, Mr. Justice Bradley said:

"It is further argued, however, that, supposing the devices to be sufficiently described, they do not show any invention; and that the combination set forth in the fifth claim is a mere aggregation of old devices, already well known; and therefore it is not patentable. This argument would be sound if the combination claimed by Webster was an obvious one for attaining the advantages proposed,—one which would occur to any mechanic skilled in the art. But it is plain from the evidence, and from the very fact that it was not sooner adopted and used, that it did not, for years, occur in this light to even the most skillful persons. It may have been under their very eyes, they may almost be said to have stumbled over it; but they certainly failed to see it, to estimate its value, and to bring it into notice. * * Now that it has succeeded, it may seem very plain to any one that he could have done it as well. This is often the case with inventions of the greatest merit. It may be laid down as a general rule, though perhaps not an invariable one, that if a new combination and arrangement of known elements produce a new and beneficial result, never attained before, it is evidence of invention. It was certainly a new and useful result to make a loom produce fifty yards a day when it never before had produced more than forty; and we think that the combination of elements by which this was effected, even if those elements were separately known before, was invention sufficient to form the basis of a patent."

The burden of proof is strongly upon the defendant to make out a clear and certain anticipation.

In *Coffin vs. Ogden*, 18 Wall., 120, 124, it was said:

"The burden of proof rests upon the defendant, and every reasonable doubt should be resolved against him. If the thing were embryotic or inchoate; if it rested in speculation or experiment; if the process pursued for its development had failed to reach the point of consummation it can not avail to defeat a patent founded upon a discovery or invention which was completed, while in the other case there was only progress, however near that progress may have approximated to the end in view."

In *Keystone Manufacturing Co. vs. Adams*, 151 U. S., 145, this Court said:

"It must be admitted that both of these patents granted to Augustus Adams, one in 1861 and the other in 1866, describe mechanical contrivances closely resembling the invention in question. * * * But, as we have seen, when the test of practical success is applied, the conclusion is favorable to the last patent.

"Where the patented invention consists of an improvement on machines previously existing, it is not always easy to point out what it is that distinguishes a new and successful machine from an old and ineffectual one. But when, in a class of machines so widely used as those in question, it is made to appear that at last, after repeated and futile attempts, a machine has been contrived which accomplishes the result desired, and when the Patent Office has granted a patent to the successful inventor, the Courts should not be ready to adopt a narrow or astute construction fatal to the grant."

Holley's report is insufficient as a defense, because it is a mere suggestion that a thing may be done, and not an instruction how to do it.

In Seymour vs. Osborne, 11 Wall., 516, Mr. Justice Clifford said:

"Whatever may be the particular circumstances under which the publication takes place, the account published, to be of any effect to support such a defense, must be an account of a complete and operative invention, capable of being put into practical operation."

In Graham vs. Gammon, Fed. Case 5668, Judge Blodgett said:

> "It is a well-settled principle of patent law that the mere suggestion that a given result can be obtained is not patentable, and does not anticipate a patent by another, but a mechanism or device must be described by which the suggested result is attained.
>
> "The mere saying, for instance, as was done a century or two or three centuries ago, that vessels could be propelled by steam, did not deprive Fitch or Fulton of their right to a patent on the mechanisms by which they accomplished that result. The mere idea that intelligence could be communicated by electricity did not deprive Morse of his patent upon his mechanism."

The Holley report is discussed by Mr. Carnegie (pp. 431, 432, 438), Mr. Kennedy (pp. 456, 457), Mr. Gayley (pp. 545, 546), and Mr. Metcalf (pp. 957-960), to whose testimony we refer.

THE JONES METHOD IS NOT A MERE METHOD OF STORING AND DISTRIBUTING METAL.

Seeking to identify the patent in suit with the prior publications and practices, some of the defendant's experts argue that the importance of the Jones method is that it is a reservoir for storing blast-furnace metal and weighing out the converter charges, and that the mixing operation is relatively of little value. This is contrary to the testimony of the men who have longest used the Jones mixer, and it contradicts the very publications upon which the defendant relies to make out its case.

1. Holley's report, which can be best trusted in its statement of the needs of the direct process, does not say that the need is of a storing vessel, but (p. 833) that "the embarrassing feature of the direct process is the irregularity in the heat—that is to say, in the silicon of the charges." And,

on page 835, last paragraph, he says: "The irregularity of silicon, as before stated, is the only difficulty." Moreover, the apparatus has been universally called a "mixer." It is true that defendant's witness, Morgan, in his desire to minimize the invention, has persisted in calling it a receiver or reservoir (p. 393, x-q. 41), but he admits that the term "mixer" is or may be the shop term by which it is known (Rec., p. 420, x-q. 175), and he himself used this term in his testimony, p. 393, x-q. 41.

2. Another, and convincing proof that the mixing effect of the invention of the patent in suit is what gives to it its real value, to the defendant as well as to the complainant, is the fact found by the Court below (Opinion, p. 711, last para.), that although one-third of the molten metal used in defendant's converters is remelted cupola metal, with which the defendant supplements an insufficient blast-furnace capacity, yet the cupola metal is not passed through the mixer, but goes directly to the converters. Now, cupola metal would need storing and distributing just as much as blast-furnace metal, but being substantially uniform it does not need mixing. If the true function were that of storage, the cupola metal would be poured into the mixer. Mixing being the sole end to be accomplished, the metal which needs no equalizing is taken directly to the converters.

3. The pains which are taken at the works of the defendant and of the complainant to stop the work at the converters whenever the mixer is drained half empty, shows that the function of the mixer is to mix and not to store. If the mixer were a storage tank, it would be drawn from until it is emptied, so as to prevent interruption of the steel-making. But even the converters are stopped when the mixer becomes half-empty, for then it no longer has a dominating pool, and ceases to perform its functions as a mixer. As to the defendant's practice in this regard, see supra, p. 37-38; and as to complainant's practice, see Gayley, pp. 26-27, 37, who says (p. 27):

"In the conduct of our operations at the metal mixer we have rigid orders that the mixers shall never be drained more than one-half, and when the metal, through any delay in the supply from the blast furnaces, reaches that point the supply to the Bessemer department is immediately stopped."

We refer also to the following testimony (Gayley, pp. 546-548; Kennedy, p. 472, x-qs. 103, 104; Nicholson, p. 109, x-q. 87; Mackey, p. 480, x-qs. 56, 57).

PRACTICE AT THE FOUNDRIES OF WHITNEY & COMPANY AND OTHERS.

Under the mistaken idea that the patent in suit includes any and every method of mixing molten metal, irrespective of the manner and purpose of the mixing, the defendant has taken testimony at length concerning a common practice of operating cupola furnaces in the manufacture of foundry castings, and argues that it is analogous to the method of Jones, and is an anticipation of the patent in suit. Our reply is that there is no real analogy; that the arts are distinct; and that, besides all this, the steps of the operation are different; the elements of Jones' claim are not to be found in the foundry practice. This matter has been considered by the Circuit Court on pages 701-708 of the opinion.

The art of making castings, for example the making of car wheels, is different from the art of steel-making, and involves different problems. In making castings the metal is melted in a cupola furnace, which is a simple cylindrical shaft, charged with alternate layers or drafts of coke and metal, each layer of metal weighing for example one ton. For the purpose of securing castings of a known and definite chemical composition—a necessity in such castings as car wheels—great care is exercised in the selection of the iron making up the successive layers; metal of known composition is selected, mixed when desired with other metal of known and selected character, and every layer is made up of the same constituents mingled in the same proportions. Each layer, when melted down and mixed by running into the hearth of the cupola, will be substantially the same as the product of every other layer in the same cupola or set of cupolas. There is no question that such definiteness of composition is attainable and in ordinary practice is attained by charging selected metal into the cupolas. The melted metal is poured into the molds from hand ladles of proper size to hold the weight of metal required to make a casting. When, as in the case of cars wheels, the individual castings are small, it is impracticable to tap the metal as required in small lots directly from the furnace into the little hand ladles. The whole tapping of the furnace, enough to fill many hand ladles, must be tapped all at once, for tapping is a hot and disagreeable job, and the tap-hole can not, without difficulty and waste, be stopped or botted while the metal is still flowing. To this mechanical difficulty is added the further one that each small ladleful, representing but a small part of a single composite layer of the iron in the cupola and not a mixture of the whole layer, might not be of the same character as the succeeding or preceding ladleful. Hence, it is the practice to set in front of the cupola a ladle into which the metal is tapped and from which it can be drawn out as rapidly as necessary, serving a function analogous to that of a tub set in front of a pump from which small buckets can be filled without need of pumping to fill each one. And a further important purpose is served by such ladle. It is made large enough to enable all the casting to be done in a few hours of the day, say between the hours of 1 and 5:30 in the afternoon. The cupola can be charged in the morning, the sand molds prepared throughout the forenoon, and the melting proceeded with until afternoon, when the ladle is filled; and then the workmen can fill their hand ladles at the big ladle as fast as they need them and without having to wait, and when, in a few hours the work of casting is finished, and the cupola becomes empty, the bottom is dropped, and the entire work is suspended until the next morning.

These purposes constituted the original reasons for installing the large ladle, which for years has been an institution in every well-equipped foundry in the United States; but in certain technical publications, and in the testimony of some of the witnesses in this case, it is stated that by its use a better mixture of iron is secured. It is upon this that the defendant relies. But here it should be noted:

1. As shown by Mr. Metcalf in the testimony cited below, the mixing is an incident, not the main purpose, of the operation. The main purpose is to concentrate the casting within a short period of the day, to enable it to be carried on rapidly and without interruption, and to dispense with too frequent tapping of the cupola.

2. The mixing is done by the running together of all the parts of a layer or draft into a single molten body, and a ladle just big enough to hold a tapping as large as a single layer of metal, say a ton in weight, or big enough to hold a tapping made up of a layer from each of the cupolas which discharge into it, would be an ideal mixer, for it would receive a whole stratum of metal from each cupola at each filling. All the mixing would be done as soon as a stratum of metal melted and ran together. And this is all that is meant when the ladle is said to mix iron. When the different constituents of each layer are united with each other and with the layers of the other cupolas, a mass of definite composition, substantially like every other draft or layer of metal in the cupolas, is obtained (Metcalf, p. 646, x-q. 130).

3. In foundry practice any process which, like Jones' invention, contemplated or permitted the occurrence of gradual changes in the character of the molten metal, would be undesirable and useless. The casting of car wheels demands an unvarying character of metal throughout the whole operation and from day to day. A gradual change, adapted to make each withdrawal an index of the next, would be a positive disadvantage. A car wheel of abnormal composition would be just as bad a car wheel, whether the change from good to

bad metal by which it was occasioned were abrupt or gradual. And in foundry work the uniformity of the metal is attained by careful and intelligent premixing of the constituents of the charge.

4. It follows that, even assuming, as defendant contends, that the large foundry ladle is designed to serve as a mixer of the constituents of the charge, yet the pool of metal in the ladle is not employed for mixing purposes, but for functions purely mechanical. Foundry work is intermittent. The casting is a hurried operation, concentrated in the latter portion of the day, and needs an accumulation of metal in order that the supply may not run short. Hence, any supposed resemblance to the Jones process, residing in the presence of a pool of metal in the ladle during casting and the replenishing of that pool, is accidental and superficial.

It is suggested, however, that although the foundry practice may not anticipate the Jones process in terms, it would suggest it to the skilled steel-maker without invention on his part. To this we answer—

1. The process of Jones, having for its essential principle the making gradual the changes in the metal, so that the converter-man may judge of one charge by the preceding one, has no real analogy to a process requiring metal of a constant composition. What is the life and essence of the Jones process would be fatal to good foundry practice.

2. Foundry practice requires the use of a cupola remelting furnace and the careful prior selection of the pig metal with which the cupola is charged. The composition of the metal in the ladle is the same as that which has been selected and mixed before melding in the cupola. The practice would not suggest the process of Jones, in which such selection of metal and all remelting furnaces are dispensed with.

3. In foundry practice, the cupolas are tapped simultaneously into the ladle. If this would suggest anything to the steel-maker, it would suggest the same kind of procedure, namely, running into a ladle the entire cast or several casts of the blast furnaces, filling it up at once or very rapidly, and

emptying it before the next tapping—a procedure which might result in the process of Deighton or Witherow, but not in that of Jones. The presence of the pool or body of metal in foundry work, being incident to the performance of the casting as a hurried operation at a part only of the day, would not suggest anything to the steel-maker as worthy to be followed in his special art.

4. The arts are different—the purposes, principles and results are diverse. The resemblances are verbal, and not essential.

5. But the argument safest to follow, because it admits of no speculation, and treats the question as one of fact and history, is the argument which we stated above in discussing Holley's report; namely, that the foundry practice never did suggest the Jones method. The need was pressing (Holley, p. 845, line 20); the foundry practice was widely followed all over the country, side by side with the manufacture of Bessemer steel; in the case of the Lackawanna Steel Company, it was practiced in the same works where converters were being operated (Wolf, pp. 140, 142), and yet it did not suggest or lead to the Jones invention. The highest development which the Bessemer art had reached was to use the cupola furnace for remelting the pigs, or, where the direct process was employed, to use such direct process without substantial modification. Complainant's witnesses, skilled steel-makers, say that, although they knew all about the foundry practice, it never occurred to them that it held any key which would solve the difficulties of using direct metal. But when the difficulties were overcome by Jones, other steel works of this country and Europe imitated his process, and they copied, not from the foundry practice, but from the method which Jones was practicing at the Edgar Thomson Steel Works. From the Illinois Steel Company, Forsyth visited Braddock and then copied the Jones mixer (p. 279, x-qs. 71-76); from the Cambria Iron Company, Morgan visited Braddock, got from Gayley the details of operation of the Jones mixer, and copied it (pp. 391-393); and so with the others.

It is acknowledged that the Jones method was practically new, metal had never been mixed in that way before, it revolutionized the art of steel making, did away with the remelting of pig metal in cupolas and the sulphur contamination arising therefrom, cheapened greatly the cost of manufacture, and reduced the "defectives" one-half as compared with direct metal. Nor is it seriously contended that the principle upon which it is based—treating the metal so as to make the fluctuations of its character gradual—was ever before known.

These facts afford to the questions raised by the defense a safer answer than the speculations of experts, who, though they never did think of the Jones method, prior to Jones' invention, now say that it would have been suggested to any one, although they themselves were so blind as not to see it.

A further proof that the Jones method was not an obvious application of the well-known Whitney foundry practice is that, even when it was introduced at Braddock by Captain Jones, the managers of other steel works were so unprepared for the radical change which it inaugurated, and were so uncertain as to its operation, that they waited for some time to watch its success, before they copied it. This is admitted by Mr. Forsyth, defendant's expert, who says (p. 279):

> "x-Q. 73. In your opinion, did not this delay in the introduction of the Jones mixing reservoir and process, at works other than those of the complainant company, result from a desire to ascertain first the practicability or value of such process and apparatus?
>
> "A. Undoubtedly the manufacturers were waiting to see how the process would result and what difficulties arose in operating the mixer. Possibly, also, they were deterred from using it by the idea that it would be necessary to use the Jones apparatus."

To this suggestion of Mr. Forsyth, it may replied, what need was there of waiting at all if the method and its success were so obvious and well-known; or why waste time on consideration of the Jones apparatus, if the prior apparatus of Witherow and Deighton and the method of their use had been so clearly understood?

Defendant's testimony concerning the Whitney practice.

The testimony concerning the Whitney foundry practice is given by J. R. Whitney, formerly one of the proprietors of the foundry, and A. J. Frederick, a molder (pp. 115-124). They say that three cupolas were used, set side by side and discharging through a common runner or trough into the ladle. The cupolas were charged with alternate layers of coke and pig iron. Each layer of iron weighed about 2,000 pounds, and was composed of varieties of metal which were separately tested and selected in proper proportion to yield when melted a product of definite character (Whitney, p. 116, q. 6).

The three cupolas were tapped simultaneously at stated intervals of about 15 minutes, and at each tapping about 2,000 pounds, or an amount equal to one draught or layer of iron, was drawn from each cupola. About 6,000 pounds of iron, therefore, ran into the ladle from the three cupolas at every tapping. *

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* This statement of the weight of metal in the individual tappings is apparently inconsistent with Mr. Whitney's testimony (p. 121, q. 44), but a simple calculation will show that our figures are correct. Whitney says (q. 11, p. 117):

"I suppose it took perhaps 10 to 15 minutes between each tap, generally, say, about 1 o'clock, and would be done generally between 5 and 6. There would be 25 to 30 tons of iron in each cupola." "Q. 12. Am I correct in understanding you that at the Whitney works you tapped at intervals of 15 minutes, more or less, through the day, from the three cupolas into a large ladle holding from 12 to 15 tons? * * * A. That was what I tried to make plain."

Now, if they started to cast about 1 p. m. and finished between 5 and 6—say, 5:30 p. m.—and melted from 25 to 30 tons—say, 27½ tons, or 55,000 pounds—in 4½ hours, they must have melted 12,222 pounds per hour. Taking the taps at 10 minutes apart—the shortest interval which Whitney states—giving 6 taps per hour; and dividing 12,222 by 6, we have 2,037 pounds, or about one ton as the weight of a tap of one cupola. And that this must be so, appears from the testimony of J. E. Fry, who says, as the result of measurements, that each of the Whitney cupolas could hold as much as 2 tons of metal (Rec., p. 658-9, q. 3), and thus shows to be incorrect the estimate given by Mr. Whitney (Rec., p. 121, x-q. 45).

When the ladle was nearly full, the molders drew the metal into the hand ladles and poured it into molds. The casting was continued from about 1 o'clock until about 5:30 in the afternoon, at which time the bottoms of the cupolas were dropped and the day's work concluded. Each tapping introduced into the ladle 6,000 pounds or three draughts of metal, an amount of metal equal to about one-fourth the greatest capacity which defendants claim for it, and nearly one-half what we believe was its true capacity, namely about seven tons (Fry, p. 496, q. 26; Stipulation, p. 670-1). As the tapping from each cupola represented the whole of a single layer or draught of metal, it would be a collection of all the constituents of that layer melted and run together, and would therefore be the same in character as all the other draughts or tappings (Whitney, p. 117, q. 9; p. 117, q. 12). It is to this feature of the process, namely, tapping out at least an entire draught at a time from each cupola, instead of tapping only an amount sufficient to fill a small casting ladle, that Mr. Metcalf refers in his testimony (x-qs. 127-132, p. 645; Re-d. q. 185, p. 654, and x-qs. 204-206, p. 657; and see Gayley, pp. 575-576).

In this Whitney practice the employment of the ladle to effectuate the concentration of the casting into a short period of the day is a striking feature. The mixing was completed when the contents of the several furnaces were tapped into the ladle simultaneously, and the success of the operation depended upon the *substantial identity* of the components of the several draughts. The presence of a pool of metal in the ladle played no part in the mixing operation; for if the maintenance of a pool of metal had been regarded as essential, it would have been furthered by tapping the cupolas separately, thus introducing into the ladle small quantities at a time, instead of, as was the case, tapping all three cupolas at once, and thereby delivering to the ladle at each tap a large volume of six tons of metal.

In none of these things is there any suggestion of the peculiar characteristics of the Jones process, much less of the use of Bessemer converters or of dispensing with cupolas.

The Altoona foundry.

The practice at the foundry of the Pennsylvania Railroad at Altoona is described by defendant's witnesses Spielman and Osbaugh (pp. 177-188). It was substantially the same as the practice at the Whitney foundry.

The Altoona cupolas were charged in the usual manner with carefully selected varieties of pig iron (p. 181, q. 36), and their spouts led to a common ladle holding seven tons, the same size as the Whitney ladle, but incorrectly described in "London Engineering" as about 20,000 pounds. Each cupola was charged with about 40 tons of iron, and about noon of each day the workmen began to tap them simultaneously into the ladle (p. 180, q. 21), each tapping filling the ladle about one-half full and therefore amounting to about 3 or 3½ tons. When the ladle was full the casting began and continued until about 4:30 p. m. (q. 16-18, p. 179), there being intervals of 15 to 20 minutes between each tap. So far as mixing was concerned, the advantages of this procedure, other than the mere collection in a molten state of the constituents of the several draughts and the running together into a single batch of the simultaneously tapped products of the two cupolas, could not have been substantial, for Osbaugh says (p. 187, qs. 36, 37) that the variation in the character of the metal was only occasional and slight.

As in the Whitney case, so in the ladle at Altoona, nothing was accomplished by the maintenance of a constant pool of metal. If it had been intended to use the ladle for any such purpose as that of Jones, the cupolas would have been tapped at separate times and not, as was the practice, simultaneously and in quantity sufficient at each tapping to fill the ladle half-full. Spielman says (p. 181) that the ladle was made to hold seven tons,because he was satisfied that the larger the body of iron the more uniform the mixture, but the operation was designed only to afford the advantages of mixing together in a batch several tappings of iron, and thus to secure a constant product, and there was not as in Jones' method any purpose of grading the variations in the metal. The principle of the Altoona practice, if applied to the manufacture of steel, would be worthless, for it would involve pouring into a vessel at stated intervals a large volume of irregular blast furnace metal, tapped simultaneously from several furnaces, and it would produce at each addition marked and abrupt changes, not only in the composition, but especially in the temperature of the charges.

Here again in the Altoona practice we fail to find any true analogy to the method of Jones. It would have surprised Sir Henry Bessemer to be told that the converter practice which bears his name was a similar or analogous art to the remelting of metal or making of castings in an iron foundry.

The High Bridge foundry.

The foundry of the Taylor Iron and Steel Co., at High Bridge, N. J., is described by defendant's witness Taylor (p. 285). In that foundry a ladle of 20 tons capacity was set before a cupola whose entire melting for the day was only 20 tons. It was the practice to drain the cupola entirely into the ladle and thus to fill the latter; then, after the cupola was drained, to proceed rapidly with the work of casting (p. 286, x-q. 15). The large ladle was substituted in place of a somewhat smaller ladle which had been used before. The purpose, so far as mixing was concerned, was to cause the constituents of the draughts to run together (pp. 288, 426). It appears from the testimony of John M. Sherrerd, the superintendent of the Taylor works (p. 607, q. 13) that the large ladle has since been abandoned, and Mr. Sherrerd says (p. 607, qs. 11, 12):

"A. 11. We have in use at High Bridge four cupolas; the two largest ones have each a receiving ladle, but the cupolas being situated some distance apart, each ladle can receive the metal from its own cupola alone. The other two cupolas are small ones and have no fixed receiving ladles, nor can they be tapped into the receiving ladles of the largest cupolas.

"A. 12. I think they hold about five tons apiece."

The abandonment of the large ladle, and the substitution of small individual ladles placed at the several cupolas, shows that no mixing in a pool of metal could have been intended, or at least that no benefit was ever noticed or derived from it.

Mr. Sherrerd, who is an experienced steel works superintendent, as well as a skillful founder, compares the High Bridge practice with the method of Jones, and to his testimony we refer (pp. 607-608).

Kirk's treatise.

In Kirk's Treatise on founding metals, on page 825, after describing the charging of a cupola with a mixture of different brands of iron, it is stated: "A quantity of molten iron should be kept in the cupola, or in the large ladle, so as to give the different brands of iron a chance to mix." Only one cupola is here mentioned. Kirk's idea was that the constituents of each layer of the cupola-charge should be caused to run together either in the hearth of the cupola or in an external receptacle, in order that they might mingle before being cast into the molds (W. Metcalf, p. 628, q. 23).

Practice at the Fulton, Fort Pitt and Lackawanna foundries, and the casting of Rodman's guns.

Testimony has been taken by the defendant concerning the practice followed at some foundries, when making large castings, of collecting in a single vessel the tappings from several melting furnaces, so as to accumulate a body of metal sufficiently great to fill the mold. The testimony is quite irrelevant to the second claim of the patent in suit, and in answer to it we refer to the testimony of Mr. Metcalf (pp. 617-621).

At the Lackawanna foundry, to which we have already referred, the cupola ladle held only 3 or 4 tons (p. 142, q. 21).

Rebuttal testimony concerning the Whitney practice.

The rebuttal testimony concerning the foundry practice above discussed is peculiarly interesting because of the varied training of the witnesses. The practice is explained by Julian Kennedy and James Gayley, skilled blast furnace managers and steel works superintendents (Kennedy, pp. 452-456, 472, 474; Gayley, pp. 552, 575-576); by John E. Fry, who has had long experience as a foundryman and as a Bessemer superintendent (pp. 496, 523-524, 658-669); by William Metcalf, who for ten years was superintendent of the Fort Pitt Foundry and is a well-known steel manufacturer and an author of a book on steel (Metcalf, pp. 625-628, 644-646, 654-655-657); and by John M. Sherrerd, to whose testimony we have already referred.

The Jones method dispenses with the cupola practice.

The Jones invention entirely dispenses with the necessity of remelting the iron in cupolas. It, therefore, would not be anticipated by any process of which the cupola practice was a necessary element.

Defendant's counsel have endeavored to show an analogy between the Jones process and a prior practice which was testified to by Mr. Metcalf (p. 653, qs. 181-184), and which consisted simply and only in using an open-hearth furnace instead of a cupola for remelting pig iron for puddling furnaces and Bessemer converters (q. 181). In this operation as in the cupola, cold pig iron was melted in order to furnish a supply of molten metal, the operation being continuous throughout the day.

It involved many objections and was eventually abandoned, (Metcalf, p. 654; 656, x-q. 195).

There is no resemblance in this to anything which Jones did; and Mr. Metcalf says that in all his reading and knowledge of the art "there was nothing that ever suggested to me, or I think, would suggest to any engineer, the designing or carrying out of the Jones method."

THE BESSEMER CUPOLA LADLE.

It is urged that the patent in suit was anticipated by a practice, common in steel works prior to Jones' invention, of tapping iron from the cupola furnaces into a receiving ladle from which it was poured into the converters. Such ladle was used by the Pennsylvania Steel Company, the Cambria Iron Company and the Lackawanna Iron and Steel Company. It is considered on pages 697-701 of the opinion of the Circuit Court.

The facts are as follows: The cupolas which, prior to Jones' invention, were employed for remelting pig iron for the converters were individually of too small capacity to yield a tapping large enough to make a single converter charge. The tappings from several cupolas must be added together to make up the required bulk of metal. Hence, it was a common expedient, introduced by Mr. Holley, to set upon scales in front of the cupolas a large "accumulating ladle" into which the tappings from several cupolas could be drawn at once and from which the charge, so "accumulated," could be delivered to the converter vessel. And for purposes which are fully explained by Mr. Lauder (Rec., p. 66, q. 3; p. 73, q. 41), it was the practice to make the capacity of the ladle greater than one converter charge, so that a small excess of metal above that required for a charge could be collected, thus making it easier to weigh out the heats. The converter man was "sure to have always enough." The larger capacity made it possible to receive in the ladle the full tapping of the cupolas, and rendered it unnecessary to shut off the flow of metal from a cupola prematurely when more metal than was needed for a converter charge happened to be yielded at a tapping. The cupola tap-men could let the surplus run out into the ladle, instead of having to stop it by "botting up" the tap-hole, which while the hot metal was running, was a hot and difficult operation. The large size of the ladle also compensated for the lessening of its internal diameter which frequently resulted from the collection of a skin or "skull" of iron or slag upon its interior lining, and which otherwise would reduce its capacity unduly.

The advantages of using a ladle of larger capacity than a single charge were purely mechanical advantages. They had no bearing upon the process of steel manufacture as such. The significance which defendant's experts give to the matter depends upon an unimportant incident which they seek to magnify to the proportions of a genuine analogy; namely, that after each charge of metal was withdrawn from the cupola ladle, when the ladle was of greater capacity than one converter charge, a residuum of metal would sometimes be left in it—generally less in amount than a converter charge and usually only a small fraction of a charge—and into such residuum the next tapping from the cupolas would be drawn.

Now, in order to make out of these facts an anticipation, the defendant must prove: 1st. That the tappings from the several cupolas were substantially diverse in character, so much so as to be made perceptibly better for conversion by being mixed together, and that this was recognized by users of such ladles; and 2d, that a substantial benefit in respect of mixing was obtained, and was known to be obtained, by virtue of the residuum of metal left in the ladle after the taking out of the converter charge. Mere accidental resemblance to the patent in suit, without a substantial and known performance of the functions of the patented process, would not be sufficient to establish the defense under the rule of Topliff vs. Topliff, 145 U. S., 156.

The defendant has failed to make out either of the two premises above mentioned.

A brief review of the testimony will suffice:

The cupola practice at Steelton, Pa.

Concerning the practice at the Pennsylvania Steel Company's plant at Steelton, Pa., defendant's witness Campbell (p. 124) testifies that the ladle into which the charges from the cupola were tapped had a capacity of from 35,000 to 40,000 pounds. The amount of iron contained in it depended upon the speed at which the converter was worked, so that the residue left in the ladle after charging the converter varied greatly, according to Campbell, from 5,000 to 20,000 pounds. The amount of iron tapped into the receiving ladle, "may be just sufficient for a charge, or it may be enough for two charges, or it may be any amount between," (p. 125, q. 9). The running together of the tappings, in his opinion, produced a better averaging of the metal, but neither Campbell nor Wood who testifies for defendant on the same subject, professes to say that the leaving of a residuum in the ladle contributed anything to this end.

The cupola ladle at defendant's works.

The defendant relies upon its own use of a cupola ladle prior to the time of its adoption of the Jones method as a substantial anticipation of the patent in suit. But on the contrary, the defendant's former practice not only affords proof that it did not anticipate the patent, but it shows convincingly that none of the users of these accumulating ladles had any conception of the principles of the Jones invention. The facts in this regard appear in the testimony of defendant's witness McGarthy (q. 14, p. 135), and are collated on pages 697-700, of the opinion of the Circuit Court. It there appears that the many changes in the capacity of the cupola ladle that were made by the defendant from 1871 to 1889, were always in the direction of smaller capacity relatively to the weight of the converter charge. To quote from Judge Buffington's opinion (p. 700): "In the latest development of the ladle the residue had dropped to 7,000 pounds, while the incoming metal was raised to 28,-

000 pounds, so that the proportion of the dominating pool to the incoming metal had changed from three and two to eight and four." Here was a deliberate retrogression from the features in which the defendant now claims the cupola-ladle practice resembled the Jones invention, and this action of the Cambria Iron Company, more forcibly than all the present theories of its witnesses, shows that its practice had no substantial analogy to the patent in suit.

In answer to q. 16 (p. 135) McGarthy strikingly confirms the testimony of Mr. Lauder, cited above on p. 89. When asked by defendant's counsel to state the reason or advantage of using a large cupola ladle, he does not say that any function of mixing was performed by a pool of metal, but in almost the same language as that of Mr. Lauder he says:

> "A. 16. The plant would have to be changed to run so close. It would not be practical to work so close as just to tap the exact amount. The surplus iron gives us something to go on in weighing our charges; we are not cut down to a point. Sometimes heats are larger, sometimes smaller. It is strictly necessary to have a surplus back in your ladle under the present system of working."

In the next answer, McGarthy says that the union of metal from several cupolas produces a mixing; but no function is ascribed to any residuum of metal.

Defendant's witness, Hershey (p. 137), attributes no advantage to the mixing of the cupola metal.

R. W. Hunt (p. 289) testifies concerning the cupola practice at the Cambria works. It is in response to a leading question (q. 11, p. 291), and by an answer which may well refer only to the simple mixing of several tappings in a ladle, that he indicates that benefit in mixing was derived from the presence of a residuum of metal in the ladle; but the contrary is proved by other portions of his deposition. In answer to q. 14 (p. 292), Mr. Hunt states that the capacity of the Cambria cupola ladle was 1½ converter charges, so that only a small residuum could have been left after the pouring of each charge, and in answer to q. 10 (p. 291), he states, as Mr. Fry had elsewhere said, that there was no absolute rule about leaving any residual metal in the ladle, *whether any was left or not depended upon the relative speed of working of the converters and the cupolas, and that "if the blowing was close up to the melting, the metal would be poured as soon as sufficient amount for a heat was accumulated.*"

The practice at the Troy Iron and Steel Works was the same as at the Cambria (Hunt, p. 292).

It is significant that defendant's expert, Joseph Morgan, gives no testimony concerning the cupola ladle at the Cambria works, although he testified at large on other points, and his long connection with the defendant company in the management of those very works, rendered him a competent witness if it had been possible to prove by him any facts in support of defendant's theory.

Cupola ladle of Lackawanna Iron and Steel Co.

Defendant's witnesses T. G. Wolf (p. 140) and G. F. Barnard (p. 144) say that the ladle of the Lackawanna Iron and Steel Company had a capacity of from 20,000 to 25,000 lbs., and the converter-charges were from 11,200 to 15,600 lbs.—considerably more than half of the full capacity of the ladle. Neither of these witnesses attributes any mixing effect to the practice of not draining the ladle, and in cross-examination Barnard says (p. 147):

"x-Q. 28. It was a matter of indifference to you, was it, how much metal was left in the ladle after charging the converter, so long as there was enough metal left in the ladle to insure proper weighing?

"A. Yes."

Complainant's proofs concerning the Bessemer Cupola Ladles.

Complainant's witness, John E. Fry, testifies that while he was superintendent of the steel department of the Cambria

Iron Works, from 1871 to 1881, no mixing function was desired or intended to be performed by the cupola ladle (Rec., pp. 492-493), and on pages 496-8 he answers Mr. Hunt's statements concerning the Cambria practice, and says (p. 497):

"During all the time Mr. Hunt was there and the eleven years I was employed in that department, there was no recognition by Mr. Holley, by Mr. Hunt, by myself, or by any other person, of any mixing operation performed by the cupola-ladle. In the light of the practice such an assumption would have been absurd."

William Golding, who was successively the foreman and the blower and the superintendent of the steel department of the Pennsylvania Steel Company's plant from 1871 to 1881, testifies that the cupola metal needed no mixing, and he says (p. 530):

"The object of using the ladle for the purpose of a mixer was never once thought of by me, nor by any one as far as I know."

J. S. Kennedy, who was superintendent of the blast furnaces at the Pennsylvania Steel Company's works from 1881 to 1887, and who frequently visited the cupola plant to see how his iron was working, says (p. 534):

"The irons were carefully selected from the different piles to make up the cupola charges. * * * I have often seen the ladle drained in pouring into the converter. * * * It did not hold two full charges. * * * I never knew of the ladle being used for mixing purposes. If such was the practice I would have known it. * * * The capacity of the ladle was so small and the size of the pool of metal, when there was a pool, was of such varying size that I do not see how any mixing could be accomplished. * * * Q. 18. When was this ladle drained, and when would there be some metal left in the ladle? A. There would be no regularity in the process. The rate at which the converters take the metal does not always correspond with the rate at which the cupolas are melting."

It is a significant fact, inconsistent with the defendant's contention that the operation of the large ladle was analogous to the Jones mixing process, that recently the Pennsylvania Steel Company's plant was remodeled, and the large cupola ladle is no longer used. A smaller 10-ton ladle holding one heat has been substituted, and the practice is to substantially drain it at each charging of the converters (John S. Kennedy, p. 535; Camp, p. 600).

John M. Sherrerd, who was in charge of the metallurgical work of the Troy Steel and Iron Company from 1881 to 1894, covering the time when R. W. Hunt was engaged at the works of that company, testifies (pp. 605, 607), that the only reason why the cupola ladle was made of somewhat larger capacity than a single converter charge was a mechanical reason, and that it never occurred to him, and he never heard it stated by any one, that the ladle was useful for mixing purposes.

Mr. Gayley says (p. 552):

"A. 210. I had never heard of the practice of leaving some metal in the cupola charging ladle for the purpose of mixing until I read the testimony of defendant's witnesses in this case. In all my visits to the various steel works of the country I have never heard it mentioned that such a practice was conducted, and I feel certain that if it had been I should have been familiar with it. The residuum is the excess necessary to obtain the exact charge of the converter. Its sole purpose was to secure a sufficient weight, and it was too small to have any mixing effect."

We shall not quote further the testimony of complainant's witnesses on this point. It is concise, and we respectfully ask that it be read as part of our brief. It shows persuasively that the supposed analogy of the Bessemer cupola practice to the method of Jones was never discovered until the exigency of this suit had arisen, (Lauder, p. 73; Gayley, p. 552, q. 210, p. 584, q. 360; Kennedy, bottom 453-4, 456, q. 16-17; Fry, pp. 491-493, qs. 10-13; Wiliams, p. 485, qs. 18-19; J. S. Kennedy, pp. 538-9; Metcalf, pp. 629-630, qs. 24-25; Sherrerd, pp. 605-606, qs. 4-6).

The testimony of Sherrerd and J. S. Kennedy last cited shows the incorectness of the suggestion of defendant that the small residuum left in the Bessemer cupola ladle equalizes the temperature of the converter charges. It would have a contrary tendency (Sherrerd, p. 605, q. 5; Kennedy, p. 538, qs. 48, 49; Fry, p. 493, para. 6).

Certain facts appearing in the defendant's proofs, prove that the Bessemer ladle practice had no analogy to Jones' invention, and was not useful for mixing.

1. To establish that the Bessemer cupola ladle was efficient as a mixer of iron for conversion, it is necessary to show that the cupola metal needed mixing, that it was substantially irregular in composition. But the contrary is admitted by defendant's expert witness, Mr. Forsyth, who says (p. 281):

"x-Q. 88. In the exclusive use of cupola metal in Bessemer practice would you consider the degree of ununiformity in the charge of molten metal to the converter to make it important to employ the mixing reservoir?
"A. No; I should say it was not necessary."

The uniformity of cupola metal is produced either by careful analysis and selection of the metal pigs, as in the practice described by Durfee (p. 241), or by rejection of all unsuitable pigs, and the blending of the remainder by dumping them promiscuously into bins and thence charging them into the converters, as described by Morgan (p. 379, para. 4). See also Carnegie (p. 430); Gayley (pp. 32, 58); J. S. Kennedy (p. 534, q. 13).

2. A further proof that cupola metal needs no mixing, and is not benefitted by mixing, is afforded by the fact already adverted to, that in defendant's works, where part cupola metal and part blast furnace metal is employed, *the cupola metal is taken directly to the converters and is not passed through the mixer.* Defendant's practice disproves defendant's theory.

Julian Kennedy says (p. 458):

"The reason for not putting the cupola metal in the mixer is, that it is not necessary, cupola metal being sufficiently uniform without mixing. They put all the blast furnace metal through the mixer, in my opinion, because it is necessary to do so to get sufficient uniformity of heat and composition."

See also Fry, p. 495, qs. 16, 17, and Gayley, p. 589, x-q. 378; p. 590, q. 388.

3. A convincing proof of the real function of the Bessemer cupola ladle is to be found in the published descriptions written prior to the institution of this suit, and before there had arisen any inducement to seek for functions and purposes other than those properly belonging to it. Chief among these is an article written by defendant's witness, R. W. Hunt, in 1876 or 1877 (Rec., pp. 811, 820, last para.), quoted on page 698 of the opinion of the Circuit Court.

In this description there was no word of the mixing which Mr. Hunt now, testifying as an expert, asks us to believe was a function of the ladle. The only functions which he ascribed are the facilitating the weighing of the metal, and the accumulating of enough metal to make up a converter charge, thus incidentally enabling the cupolas to be run independently to some extent of the converters when the working of the converters happens to be delayed, the same functions which are stated in the testimony of Mr. Lauder and Mr. Fry. The evidence of Mr. Hunt's paper written in 1876, when he was using the cupola ladle, is more to be relied upon than the afterthoughts of his testimony of 21 years later (National Company vs. Belcher, 71 F. R., 878).

Mr. Hunt's published statements are confirmed by the publications of Holley cited on page 699 of Judge Buffington's opinion. In Holley's very full description of his intermediate cupola ladle there is no suggestion of any mixing. The supposed function of the ladle now relied upon to anticipate the patent in suit was never known to Holley, by whom the ladle was invented and installed (last two lines of p. 797, p. 798, line 14).

THE JONES METHOD NOT A MERE DOUBLE USE.

We have already shown that the foundry and cupola practices are inherently different from the Jones method in the steps of their procedure, but aside from this, the analogies which defendant has suggested were discovered under the incentive of the strongest self-interest. These prior practices were known for years to the steel industry, but they never did suggest the Jones invention; and we may add that when the Patent Office allowed the patent in suit with full knowledge of their existence, a presumption of validity arose from the grant which should not lightly be set aside on mere argument or by narrow and astute construction.

And much more than ordinarily do the rules favorable to patents apply in the present case, because the underlying principle of the Jones invention—the grading as distinguished from the mere mixing of the composition and temperature of the successive converter charges, the making of the "fluctuations" gradual—was a new principle hitherto unrecognized in plans for improving the steel-making art, and would have been of positive harm, if attempted to be applied in other arts wherein molten metal is used.

Our position is supported by the authorities:

In Potts vs. Creager, 155 U. S., 605, a machine for grinding clay was held not to be anticipated by a prior machine for polishing boards, though of like construction, and this Court said (p. 607):

> " * * * We have recently upheld a patent to one who took a torsional spring, such as had been previously used in clocks, doors and other articles of domestic furniture, and applied it to telegraph instruments, the application being shown to be wholly new (Western Electric Company vs. La Rue, 139 U. S., 601). * * * Indeed, it often requires as acute a perception of the relation between cause and effect, and as much of the peculiar intuitive genius which is a characteristic of great inventors, to grasp the idea that a device

used in one art may be made available in another, as would be necessary to create the device *de novo*. And this is not the less true if, after the thing has been done, it appears to the ordinary mind so simple as to excite wonder that it was not thought of before."

This authority also rules that a new use of an old process may be patentable to the same extent and for the same reasons as the new use of an old apparatus, for the Court cited Crane vs. Price as showing that it was patentable to substitute anthracite coal for bituminous coal in smelting ore, inasmuch as it produced better iron at less cost.

And that a new use may be patentable where the result justifies it—even when analogous to the old uses—appears on page 606, where the Court say:

"If the new use be analogous to the former one, the Court will undoubtedly be disposed to construe the patent more strictly, and to require clearer proof of the exercise of the inventive faculty in adapting it to the new use, particularly if the device be one of minor importance in its new field of usefulness."

In *National Cash Register Company vs. Boston Cash Indicator Company*, 156 U. S., 502, 515, the Supreme Court say, italics not in original:

"Indeed this use of the connecting mechanism can hardly be termed analogous to such similar mechanisms as had been previously used; *but even if it were*, the results are so important and the ingenuity displayed to bring them about is such that we are not disposed to deny the patentees the merit of invention."

Not only must the prior device or practice be the same in form in order to anticipate a patented invention, but its principle of operation and its function must be the same. The inventive thought of the later device must have been present in the mind of the inventor or user of the earlier device or process.

In *Topliff vs. Topliff*, 145 U. S., 156, 161, this Court said:

"It is not sufficient to constitute an anticipation that the device relied upon might by modification, be made to accomplish the function performed by the patent in question, if it were not designed by its maker, nor adapted nor actually used for the performance of such functions."

In *Clough vs. Barker*, 106 U. S., 166, it was proved that a pre-existing device had the same construction and was capable of the same operation as the patented device, but the Supreme Court said (p. 176):

"The structure was not designed for the same purpose as Clough's, no person looking at it or using it would understand that it was to be used in the way Clough's is used, and it is not shown to have been really used and operated in that way."

As the Jones patent was for a method, proof that the apparatus used in the practice of that method was old or did not involve invention is quite irrelevant. Thus in *Fermentation Co. vs. Maus*, 122 U. S., 413, where the method involved certain manipulations of beer while undergoing fermentation, the Supreme Court say:

"It is, therefore, a process or art. The apparatus for carrying out the process is of secondary consequence, and may itself be old, separately considered, without invalidating the patent, if the process be new and produces a new result."

If the alleged anticipations are very old the presumption is that they do not contain the invention, because otherwise they would have come into use in the art to which the patent in suit relates.

In *Fisher vs. American Pneumatic Tool o.*, 71 Fed. Rep., 523, 526, the Court of Appeals for the Second Circuit say:

"Though marble cutting and engine building were each old arts, no improvement upon the mallet and chisel appeared until the tools of McCoy and Bates came into existence. If the turning of a rock drill into a marble or granite cutter was a thing to be had for the asking, it would seem that the transformation would have been more promptly made."

The Circuit Court said in the present case, p. 708:

"We deem it proper to say that careful study and matured thought satisfies us that the Jones invention was a marked advance in the steel-maker's art. In other cases it has been held that if the change in question is one which would not occur to the practiced eye of the ordinary mechanic, such fact might tend to show that the step involved invention. But here was a step, a desideratum, which not the skill of the ordinary mechanic, but the keenest intellect of men technically taught in the schools of different countries, and practically trained at the furnace bosh, was seeking for years to reach and failed to attain. A great industry was interested and alert upon the solution of the question. The evil was a recognized one, and was discussed at the gatherings of the master minds of that industry, but no one met it until the simple and effective key furnished by Jones unlocked the gate which had so long barred advance."

JONES' INVENTION PATENTABLE AS A PROCESS.

We submit the following answer to the question raised by the defendant's 19th assignment of error in the Circuit Court of Appeals—whether the patent in suit covers a valid process as distinguished from a mere mechanical manipulation. This defense was considered by the Circuit Court on pages 708-709.

The objection here considered is artificial and technical, because it ignores the merits of the patented invention and the value of its contribution to the art, and seeks to defeat the patent on the ground that its *form* is not such as to entitle it to the protection which the Constitution, under the broad terms of Art. 1, Sec. 8, clause 8, authorizes.

Judge Buffington says (Rec. p. 708):

"Section 4486, R. S., authorizes the grant of a patent to any person who has invented or "discovered any new or useful art * * * or any new and useful improvement thereof." *Cochrane vs. Deener*, 94 U. S., 780, defined the term 'art' as used in the statute to be synonymous with 'process,' and a process was defined to be a 'mode of treatment of certain materials to produce a given result, an act or series of acts performed on a subject matter to be transformed and reduced to a different state or thing."

The terms of the statute are therefore broad enough to cover the present case if the operation to which Jones subjects the pig metal—namely, pouring it into and through a regulating pool, whereby the metal is brought from a state of abrupt fluctuations to a state of gradual fluctuations—is properly definable as an "act or series of acts" reducing the metal "to a different state."

The statement of this proposition carries its own answer.

In *Risdon Locomotive Works vs. Medart*, 158 U. S., 68. the following rule was stated by Mr. Justice Brown:

"It may be said in general that processes of manufacture which involve chemical or other similar elemental action are patentable, though mechanism may be necessary in the application or carrying out of such process; while those which consist *solely in the operation of a machine* are not. Most processes which have been held to be patentable require the aid of mechanism in their practical application, but where such mechanism is subsidiary to the chemical action, the fact that the patentee may be entitled to a patent for his mechanism does not impair his right to a patent for the process, *since he would lose the benefit of his real discovery*, which might be applied in a dozen different ways, if he were not entitled to such patent. But if the operation of his device were purely mechanical, no such considerations apply, since the function of a machine is entirely independent of any chemical or similar action."

In the Risdon-Medart decision Mr. Justice Brown quotes the following extract from the opinion of Mr. Justice Bradley in *Cochrane vs. Deener*, to show that in a valid process the operation ***need not be chemical*** in its nature:

"A process is a mode of treatment of certain materials to produce a given result. It is an act or a series of acts performed upon a subject matter to be transformed and reduced to a different state or thing." * * * The machinery pointed out as suitable to perform the process may or may not be new or patentable. * *"

Mr. Justice Brown continues:

"It will be observed in this case [*Cochrane vs. Deener*] that the process for which the patent was sustained *was not chemical in its nature*, but as stated in the opinion of the Court, was a series of acts performed upon the subject matter to be transformed and reduced to a different state or thing."

Corning vs. Burden, 15 How. 252, which illustrates the class of unpatentable processes, involved, like the Risdon-Medart case itself, an attempt to claim the function of an apparatus. It was old to prepare the spongy balls of puddled iron for rolling, by squeezing out the slag by tilt-hammers or by alligator-jaw squeezers, which acted by percussion or compression; and all that the patentee did was to accomplish *the same expressing of slag* by a rotary cam and an opposite curved and converging surface between which the ball was rolled and squeezed. The only novelty was in the machine. Aside from the necessary function of the machine, the process was identical with the old mode of squeezing. But in the case of the Jones patent, the process as such is the essence of the invention. The apparatus is subsidiary. Its function has no necessary relation to the process.

We submit, as a result of the authorities cited in the *Risdon-Medart case*, that a process is patentable,—

1. When it involves chemical action.

2. Or where it involves some other elemental action, some application of a natural law or principle. Instance, the

telephone patent, patents for electrolysis of metallic compounds, and the driven well patent.

3. Or when, as in *Cochrane vs. Deener*, 94 U. S., 780, 788, a body is subjected to an act or series of acts whereby it is "transformed and reduced to a different *state* or thing," as distinguished from a merely different *shape*. An example of this class is the Whitney patent, *Mowry vs. Whitney*, 14 Wall., 620, in which the claim was for a process of annealing cast iron car wheels by subjecting them to a gradual cooling in a furnace chamber; and another example is the Jones process of the patent in suit.

4. That on the contrary, the mere result of a machine is unpatentable, because the "real discovery" is the machine itself. The purpose is to give to the inventor the benefit of what he has contributed to the art. (*Risdon Loco. Wks. vs. Medart*, 158 U. S., 72, lines 12-15). If he has contributed a new machine, the machine is what he should claim; if a method, which is not merely the necessary function of a machine, the method as such should be patented (*Lawther vs. Hamilton*, 124 U. S, 1).

5. That it is not an objection to a process that apparatus must be used in practicing it. In *Cochrane vs. Deener*, every step of the process required the aid of mechanical appliances.

6. That a valid process need only consist of some series of steps, and "*involve*" some chemical or elemental action. The patentee need not have been the first discoverer of the elementary principles on which his process is based. It is enough if he has applied them in a new way, or in a new order, or to effect a new result; the rule in this regard being as broad as in the case of patents for combinations of machine elements. In *Tilghman vs. Proctor*, 102 U. S. 729, the Court say: "The chemical fact [upon which Tilghman's invention was founded] was not discovered by Tilghman. He only claims to have invented *a particular mode* of bringing about the desired chemical union between the fatty elements and water"; namely, by superheating the fat and water in a boiler strong enough to prevent the water from flashing into steam.

The Hot-Blast Case a Precedent.

Judge Buffington's opinion points out the apt analogy between the case at bar and the well-known Hot Blast Case, Webster's Rep. 312, 371, which is referred to in *Risdon Locomotive Works vs. Medart,* and is discussed by Mr. Justice Bradley in *Tilghman vs. Proctor*, 102 U. S. 707, where it is made the basis of the decision.

Neilson had discovered that improved results in the working of a blast furnace, could be obtained by heating the air-blast before blowing it into the furnace through the tuyeres. It was objected that Neilson could only claim the apparatus which he described for heating the air.

Mr. Justice Bradley said (102 U. S., page 725):

> "That Neilson's patent was regarded as for a process, is apparent from what is said by the judges who had it under consideration. Thus Baron Parke at the trial had said: 'The specification and patent together make it clear what the discovery was; it was the introduction of hot air by means of heating it before it was introduced into the furnace, between the blowing apparatus and the furnace.' * * * This case of the hot-blast was commented upon in the great case of *O'Reilly vs. Morse*, 15 How. 62, and is there recognized and approved in the opinion of this Court delivered by Chief Justice Taney."

In Neilson's heating operation the air undergoes no chemical reaction, nor is it changed to any "different thing," but (to quote again from *Cochrane vs. Deener*, 94 U. S., 788), it is "reduced to a *different state*" of temperature, and that is enough to characterize the operation as a valid process.

Jones has discovered that the refining of molten blast furnace metal in the converter becomes a desirable operation, if, instead of taking the molten metal directly from the blast furnace to the converter, it be caused to pass first through a body or pool of molten metal composed of a number of portions taken from different blast furnaces, or from the same furnace at different times; successive portions being poured into such body at one end and corresponding portions removed at the other, the effect of the passage of the converter-charges through this dominant body or pool of metal being to "*reduce it to a different state*," namely, to transform the withdrawn portions from a condition of widely and suddenly *fluctuating* chemical composition and temperature, to a gradually varying chemical composition and temperature. The transformation or reduction "*to a different state*" which the metal thus undergoes is even more marked than is the transformation of the materials in the processes of the cases above cited; for in the Jones process the pool through which the metal passes grades and modifies the state of the metal in respect of its heat as well as its composition. The action is both thermal and chemical.

The relevancy of the *Hot Blast Case* becomes striking if the processes are paraphrased as follows:

The hot air blast process is a process of preparing air for use in a blast furnace, by passing it on its way to the furnace through a heating medium, whereby its state or condition is changed in respect of the temperature.

The Jones process is a process of preparing molten metal for use in the converter, by passing it on its way to the converter through a dominant pool of molten metal wherein its state is modified or changed in respect of its composition and temperature by transforming the nature of the charges from abruptly-varying charges to gradually-varying and controllable charges.

It is not an answer to this argument to say that the principles of mixing were well known. Invention of high order may be involved in a new application of old principles, and the simpler the principle, the more credit there is to the inventor in having turned it to good account in its new use. Jones does not claim every process of mixing, but a peculiar process of mixing by which new and important results are secured.

The case of *Marchand vs. Emken*, 132 U. S., 195, only serves to illustrate the rule that a claim for the necessary function of a machine is not patentable as a process. The point of that case is stated in the opinion of the Court as follows, p. 199:

> "The question, then, seems to be narrowed down to this: Does it constitute invention to stir by a well known and simple mechanical device, what had before been stirred by hand?"

The case of *Leggett vs. Standard Oil Co.*, 149 U. S. 287, which is cited so frequently in appellant's brief in the Court below, does not help their contention. The decision was simply that it was not patentable to apply to the linings of barrels, glue which had not been allowed to harden, instead of commercial glue which had been first hardened and then re-dissolved. But no doubt was suggested that the process was properly definable as a process, or that if the patentee had been the first to apply glue in a liquid state, he could have patented it.

Other authorities relevant to this question are the following:

Mowry vs. Whitney, 14 Wall., 620; *Downton vs. Milling Co.*, 108 U. S., 466; *The Driven Well Patent*, 122 U. S., 40; *Crescent Brewing Co. vs. Gottfried*, 128 U. S., 158; *Roberts vs. Dickey, Fed. Cas. 11, 889*;

Defendant's Diagrams.

Defendant's counsel argued in the Circuit Court and in the Court of Appeals that the method of the Jones patent is not essential to success, but that because of the improved blast furnace practice of modern days, it is possible now to obtain equally as good results by operating a mixer on the fill-and-empty principle. Elaborate diagrams were made to illustrate this position. We answer—

1. The argument, even if it were based on true premises, is unsound in law. A like argument was made in the case of *DuBois vs. Kirk*, 158 U. S., 56, involving a patent for a bear-trap dam, the patented feature of which was an overflow opening situated at an elevated point under the leaves of the dam and adapted *automatically* to limit the height of the

water under the leaves so as to keep it below the water level in the upper pool, and thus to prevent undue hydrostatic pressure upon the leaves. It appeared in the evidence that after having been sued for infringement the defendant discontinued the use of the infringing device, and regulated the height of the water by cocking or setting the wickets, an operation which was old in the art, and was clearly outside of the scope of the patent, but it yielded an equally good result. The argument was made that these facts showed the invalidity of the patent in suit. The Supreme Court overruled the defense, and said:

> "Plaintiff, however, is none the less entitled to his injunction by the fact that defendant is able to accomplish the same results by another and different method."

2. Defendant's argument seeks to show that a succession of groups of batches alternately mingled and emptied will afford as gradual a variation as would occur in a constantly maintained pool to which successive ladlefuls of metal are added to replace the ladlefuls withdrawn.

This conclusion is unwarranted for two reasons:

(*a*) It takes no account of the changes of sensible *temperature* of the metal, which would vary greatly, not only from batch to batch, but from the beginning to the end of a single batch. This is shown by actual experience at the complainant's works, for in draining the mixer on Saturday to close up the week's work, no additions of "successive portions" of blast-furnace metal being then made to the mixer, the last converter charges withdrawn are so cold as to require the wasteful operation of "side blowing," whereas in the ordinary operation of the Jones process the heat is kept up, and the gradations of *temperature* made as uniform as the gradations of composition, by fresh additions of molten metal in small lots or ladlefuls.

James Gayley says p. 546:

"It is impossible to fill a vessel up and to withdraw successive charges without the last charges varying so much in sensible heat from the first charges as to act in the converter like two different metals. We experience this result in our own mixer every Saturday when we drain it, for the last charges withdrawn are generally so cold that they need to be side blown.

See, also, Gayley, p. 586, x-q. 365, and Fry, p. 490-1, q. 7.

The deterioration of the metal which results where it is attempted to correct the cooling of the metal by a hot flame in the mixing vessel has been considered above on page 50 of this brief. *The matter of uniformity of temperature is of vital importance in Bessemer practice.* Kennedy, para. beginning bottom p. 446, p. 474, q. 112, Metcalf, p. 627, q. 21.

(*b*) Defendant's diagrams were not offered in evidence, and they are incorrectly made up. They are not compiled from analyses of *successive* withdrawals from the mixer, but from analyses of *alternate* withdrawals, and they purport to compare theoretical or calculated averages of batches of blast-furnace metal, with actual analyses of mixer metal. Exactness in analyzing small proportions of silicon in molten pig iron is impossible under the conditions of practice. The method of plotting employed in the diagrams would necessarily err to the prejudice of the mixer metal in which actual analyses — not averaged analyses —are taken, and would make it appear to be more variant than it is; while in the theoretically averaged batches of blast-furnace metal, the inaccuracies of analysis would be lessened by the mode of calculation employed in plotting the diagrams, viz., adding together the analyses of the several batches and dividing the sum by the number of batches so added.

We submit that defendant's denial of utility of the patented invention, is not only discredited by the fact that they have used the invention persistently, taking pains to keep their mixer "well filled up," but that the arguments on which the denial is based are fallacious.

THE DISCLAIMER.

The Circuit Court, p. 712, said concerning the disclaimer which was filed by the complainant:

"As bearing upon the question of the admission in evidence of the disclaimer filed in evidence, we are of opinion that there was no unreasonable neglect or delay in filing the same, and it was promptly called to the attention of the Court and offered in evidence thereafter. We will admit it in evidence, and in our consideration of the patent have so considered it. The power to disclaim is a beneficial one, and ought not to be denied except where it is resorted to for a fraudulent and deceptive purpose (*Sessions vs. Romadka*, 145 U. S., 41) of which there is no proof in this case. Having been made after suit was brought, the decree entered will be without costs. *Smith vs. Nichols*, 21 Wall. 117."

The purpose and effect of the disclaimer are misunderstood by the defendant.

The petition for leave to file the disclaimer, stated the reason for its filing, as follows, p. 672, para. 4:

> "The petitioner avers that at the hearing of this cause it was taken by surprise by the argument of the defendant that the portions of the specification now disclaimed enlarged the scope of the invention of the said Letters Patent beyond what your petitioner believes to be the import of the claims thereof."

In other words, at the hearing in the Court below it was argued that the portions of the specification now disclaimed* enlarged the patent beyond the import of the terms of the second claim, and made it cover cupola-ladle practices which were old in the art. The second claim covers the invention which the defendant infringes. Defendant contended that certain portions of the specification were broader than that claim. Those parts of the specification were therefore promptly disclaimed. The disclaimer removes from the specification clauses which the defendant contended had the effect of broadening the scope of the second claim. If those clauses did have the effect of broadening the patent, the disclaimer removes the objection. If they did not, the disclaimer can do no harm and is not the subject of criticism. The disclaimer having been filed in pursuance of defendant's criticisms, and to remove the grounds therefor, how can the defendant now reasonably object to it?

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* The parts of the patent which were disclaimed are as follows, referring to the specification as printed at page 871 of the record:

On page 872, para. 3, line 2-7, the words "for example by merely receiving in a charging ladle a number of small portions of metal taken from several ladles or receiving vessels containing crude metal obtained at different times, or from different furnaces, the mixing being performed merely by the act of pouring into the charging-ladle, and other like means may be employed."

On page 872, para. 4, as follows: "My invention is not limited to its use in connection with converters, since similar advantages may be obtained by casting the metal from the mixing vessel into pigs, for use in converters, puddling furnaces, or for any other uses to which pig iron may be put in the art."

On page 874, para. 3, line 7, the words "or the metal is cast into pigs or otherwise used."

It is ruled by many authorities that a disclaimer to cut out broadening portions of the specification is within the terms of the disclaimer statute (R. S., Sec. 4917 and 4922).

Whether a disclaimer is of a character warranted by the statute will depend upon whether the matter which remains in the patent is "a material or substantial part of the thing patented, and definitely distinguishable from the parts claimed without right."

Analysis will show that every part of the matters included in the disclaimer is definitely distinguishable from the subject of the second claim of the patent in suit.

The first part of the specification disclaimed (p. 872, para. 3) is:

> "for example, by merely receiving in a charging ladle a number of small portions of metal taken from several ladles or receiving vessels containing crude metal obtained at different times, or from different furnaces, the mixing being performed merely by the act of pouring into the charging ladle, and other like means may be employed."

This statement that the invention might be practiced by *merely* receiving a number of small portions in a charging ladle, the mixing being performed *merely* by the act of pouring into the charging ladle, by the repeated use of the word "*merely*," distinctly excludes the steps embodied in the second claim, where the mixing is not performed by pouring together the several charges into a ladle, but by the more complex, continuous operation of maintaining a dominant pool of molten metal to which charges are alternately added and withdrawn. This part of the specification is definitely distinguishable from the subject matter of the second claim, and does not embody the useful principle thereof, and therefore could be removed without impairing the claim or mutilating the remaining part of the description.

The second part of the specification disclaimed is on p. 872, para. 4, as follows:

"My invention is not limited to its use in connection with converters, since similar advantages may be obtained by casting the metal from the mixing vessel into pigs for use in converters, puddling furnaces, or for any other uses to which pig iron may be put in the art."

This is plainly distinguishable from the subject matter of the second claim, the fundamental purpose of which is to avoid the step of re-melting the metal for use in the converter or other furnace where it is to be subjected to further treatment. It is shown by the testimony that the method by which uniformity is secured in the cupola process of re-melting pigs is by the selection or mixing of the unmelted pigs. This is the converse of the process set out in the second claim which secures uniformity of the metal while still in the molten state in which it comes from the blast furnace and "preparatory to further treatment."

The third part of the specification which is disclaimed is on page 874, paragraph 3, line 7, being the words, "or the metal is cast into pigs or otherwise used."

The remarks made above apply equally to the matter here referred to. Moreover, the distinction between the process of the second claim and the suggestion that the metal might be cast into pigs is emphasized in the preceding part of the sentence from which the words disclaimed were taken. Here the specification (p. 874, para. 3) explains that the metal from the mixer is drawn off into cars 15, "which are transported *to the converters*, or the metal is cast into pigs or otherwise used." In short, two proceedings are referred to here, one in which the metal is drawn from the mixer into cars by which it is carried to the converters for further treatment, and the other in which it is cast from the mixer into pigs, which may be remelted for any use to which pig iron may be put in the art. Here is a distinction between the method of the second claim and the manufacture of pigs from mixer iron. In the method of the second claim the full benefit of the use of direct metal is obtained. When the metal is cast into pigs the benefits of the direct process are lost, and the method of the second claim is not used. The two things are therefore clearly distinguishable.

It is immaterial to the discussion of this point whether the matters disclaimed were old or not. The fact is that the appellee did "not choose to claim or hold by virtue of" them, and that the part retained was "definitely distinguishable" from them, and constituted "a material and substantial part of the thing patented." This complies fully with the requirements of the statute.

The Admission of the Disclaimer in Evidence.

The reason assigned by the defendant in its assignments of error in the Court of Appeals as an objection to the admission of the disclaimer in evidence was that "it was not such a disclaimer as provided by the statute." No other objection was made.

Broadly considered, the question of admission of the disclaimer in evidence was not appealable. *Roemer vs. Bernheim*, 132 U. S., 103.

The right to file a disclaimer pending suit is given by both Sections 4917 and 4922 of the statute, except in case of unreasonable delay, which was not charged by the defendant's assignments of error. If the right to file a disclaimer pending suit exists, it imports the right to offer the same in evidence, and this has been ruled by the Courts. Thus, in ***Smith vs. Nichols***, 21 Wall., 117, it was said :

> "It is objected that the disclaimers, having been made after the filing of the complainant's bill, cannot avail him in this case. Upon a fair construction of the seventh and ninth sections of the Act of 1837, we think they could be made as well after as before the commencement of the suit. It would, in such a case, be the duty of the court to see that the defendant was not injuriously surprised, and to impose such terms as right and justice might require. The question of unreasonable delay would be open for the consideration of the court, and the complainant could recover no costs. We see no reason for turning a party out of court to renew the litigation after filing the disclaimer, thus subjecting both parties to the delay and expense which must necessarily follow, and without any benefit to either."

Sections 7 and 9 of the Act of 1837 correspond to Sections 4917 and 4922 of the Revised Statutes.

So far as diligence in entering the disclaimer is concerned, the Court below in effect found that the appellee was not guilty of unreasonable neglect or delay. The Courts have construed this part of the statute liberally.

In *Seymour vs. McCormick*, 19 Howard, 106, Mr. Justice Nelson in quoting from the opinion of Chief Justice Taney in *O'Reilly vs. Morse*, said :

> "The delay in entering it [the disclaimer] is not unreasonable, for the objectionable claim was sanctioned by the head of the office. It was held to be valid by the Circuit Court, and differences of opinion in relation to it are found to exist among the Justices of this Court. Under such circumstances the patentee had a right to insist upon it, and not disclaim it until the highest Court to which it could be carried had pronounced its judgment."

The defendant cannot be charged with unreasonable delay in entering its disclaimer, as it appears from the petition for leave to introduce it in evidence, that it was apprised of the construction placed upon the patent by the defendant only at the hearing of the cause, which was held on the 11th day of January, 1898. The disclaimer was entered on February 18th, 1898, certainly within a reasonable time for such an important step.

The statute (Sections 4917 and 4922) gives the patentee or assignee the right to disclaim "***such parts of the thing patented as he shall not choose to claim or to hold by virtue of the patent or assignment.***"

The grant or right is couched in terms so broad ***as not to limit the disclaimer to cases where the patent includes matter not invented by the patentee***, for it gives him the right to hold by virtue of the patent such parts of the same as he ***may choose.***

In *O'Reilly vs. Morse*, 15 How., 427, Chief Justice Taney said:

> "The law which requires and permits him to disclaim is not penal but remedial. It is intended for the protection of the patentee as well as the public, and ought not, therefore, to receive a construction which would restrict its operation within narrower limits than its words fairly import. It provides 'that when any patentee shall have, in his specification, claimed to be the original or first inventor or discoverer of any material or substantial part of the thing patented, of which he was not the first and original inventor and shall have no legal or just claim to the same,' he must disclaim in order to protect so much of the claim as is legally patented.
>
> "Whether, therefore, the patent is illegal in part because he claims more than he has sufficiently described, or more than he invented, he must, in either case, disclaim in order to save the portion to which he is entitled; and he is allowed to do so when the error was committed by mistake."

In ***Hailes vs. Albany Stove Co.***, 123 U. S., 582, the Supreme Court said, italics not in the original:

> "A disclaimer is usually and properly employed for the surrender of a separate claim in a patent, or *some other distinct and separable matter*, which can be excinded without mutilating or changing what is left standing. Perhaps it might be used *to limit a claim to a particular class of objects*, or even to change the form of a claim which is too broad in its terms; but certainly it cannot be used to change the character of the invention."

The disclaimer which was the subject of criticism in the case last cited, cut out nothing either from the specification or the claims. It stated that the patentee wished his claim for the future to be construed in a certain specified way. This was held to be improper.

In *Sessions vs. Romadka*, 145 U. S., 41—a case which we believe amply warrants the filing of the disclaimer in the case at bar,—*the disclaimer was filed for the purpose of obviating the objection raised at the hearing in the Court below, that the patent was invalid because it covered several distinct inventions.* In reference to this, the Supreme Court said, italics not in the original:

> "The Court below * * * permitted the plaintiff to enter a disclaimer of all the claims but the one in suit. Whether these different devices were properly embodied in the same patent or not, we think this was a proper case for a disclaimer under Section 4917."

Referring in another place to Section 4917, the Court said;

> "While the language of this section provides for disclaimers, whenever through inadvertence, accident, or mistake * * * a patentee has claimed more than that of which he was the original or first inventor or discoverer, *it allows the patentee to make disclaimer of such parts of the thing patented as he shall not choose to claim or hold.* * * * We think the section broad enough to cover disclaimers made to avoid the effect of having included in the patent more devices than could properly be made the subject of a single patent.

> *The power to disclaim is a beneficial one, and ought not to be denied, except where it is resorted to for a fraudulent and deceptive purpose.*"

In *Hurlbut vs. Schillinger*, 130 U. S., 456, the disclaimer was filed to obviate the objection that the reissued patent in suit was for a different invention from that of the original patent. For this purpose certain broadening words were cancelled from the specification, *but the claims were left unaltered.* The disclaimer read as follows:

> " He (the disclaimant) has reason to believe * * * that the specification and claim of said letters patent are too broad, including that of which your petitioner was not the first inventor, and he thereby enters his disclaimer to the following words: 'And since the concrete, in setting, shrinks, the second block when set does not adhere to the first,' * * * and 'in such cases, however, where cheapness is an object, the tar paper may be omitted and the blocks formed without interposing anything between their joints, as previously described. In this latter case the joints soon fill up with sand or dust, and the pavement is rendered sufficiently tight for many purposes, while the blocks are detached from each other and can be taken up and relaid, each independent of the adjoining blocks.' Your petitioner hereby disclaims the forming of blocks from plastic material without interposing anything between their joints while in process of formation."

The first claim was not altered, but the Court held it to be properly modified by the disclaimer. It read as follows:

> "A concrete pavement laid in detachable blocks or sections substantially in the manner shown and described."

This disclaimer was held to modify the scope of the claim so as to limit it to a concrete pavement wherein the blocks were formed by interposing separating material of some kind in the process of laying the pavement. The Court says, page 471:

> "We do not think that the reissued patent, as it stood after the disclaimer, was open to the objection that it was not for the same invention as that of the original patent. Whatever there was of objectionable matter inserted in the specification, or the first claim of the reissue when it was granted, was removed by the disclaimer."

In *Schwartzwalder vs. N. Y. Filter Co.*, in the Court of Appeals for the Second Circuit, 66 Fed., 152, a disclaimer was filed limiting the patent to the use of certain chemical agents, *without changing the language of the claim.* In regard to it the Court (p. 158) said, italics not in original:

> "The literal effect of the disclaimer is to confine the claim to a method in which no other coagulants are employed, such as 'salts of iron." It is to be observed, however, that the part disclaimed is not part of the descriptive matter, *but a recital intended to enlarge the scope of the claim.* The disclaimer consequently operates only to expunge from the claim what otherwise would, by force of the recital, be incorporated in it constructively. Obviously, it was intended to obliterate the recital from the patent, and to have no other effect."

The effect of the disclaimer in the case at bar was to cause the patent to be construed as if the disclaimed matter had never been included in it.

Thus, in *Dunbar vs. Myers*, 94 U. S., 193, this Court said:

"The construction of the patent must be the same as it would be if such matters had never been included in the description of the invention or the claims of the specification."

In *Schwarzwalder vs. N. Y. Filter Co.*, 66 Fed., 152' above cited, the Court of Appeals of the Second Circuit said:

"The patent after the disclaimer is to be read exactly as though the recital had never been inserted."

The matters cut out by the disclaimer in the case at bar were not disclaimed because they were old, for neither pouring into a charging ladle small portions of crude metal from several other ladles or vessels; nor the casting of metal from a mixing vessel into pigs or for other uses in the art, *i. e.*, the steel refining art, was an old practice. They were disclaimed because they did not belong to or were "more than" the real invention, and the patentee did not "choose to claim them."

But as these matters disclaimed do not come within the definition of claim 2, it is unnecessary to discuss whether they are old or not. The specification is complete without them.

It is objected that the disclaimer was illegal in that it added an extra step to the second claim, which was the province of a reissue and not of a disclaimer.

This objection is perplexing to us, because we can see no foundation for it. We recognize clearly the proposition of law laid down in many cases, as in *Hailes vs. Albany Stove Co.*, supra., that a disclaimer "cannot be used to change the character of an invention," but we do not perceive its application to the present case. The step alleged by the defendant's fifth assignment of error in the Court of Appeals to be added to the 2d claim by the disclaimer, is "the step of refining or Bessemerizing the mixed metal."

In reply, we confidently submit two propositions: First, that this step was already contemplated by the second claim; and second, that the disclaimer could not have the effect of adding anything to said claim.

In support of these propositions we refer to the claim itself. It begins as follows:

"In the art of mixing molten metal to secure uniformity of the same in its constituent parts *preparatory to further treatment*, the process, etc."

The further treatment spoken of in the specification is, "the refining process in the converters or otherwise" p. 871, line 6 from bottom. The patentee thus refers to it in various places, viz: page 872, line 5, "I use in the refining process a charge," etc.; line 9, "and subject the metal before its final refining to a process of mixing, etc."; line 16, "each charge for the refining furnace or converter;" page 874, paragraph 3, line 6, "transported to the converters;" same paragraph, line 6 from end, "metal supplied to the converter;" line 2 from end, "deliver its contents immediately to the converters."

The main object of the invention fails of accomplishment if the molten or blast furnace metal is not directly subjected to a refining operation, and hence that is the *only* further treatment spoken of in the patent. The only other thing that is done with the mixer metal is to cast it into pigs, which is not a treatment, but on the contrary a cessation of treatment. Such pigs would require to be remelted before they could be used. The prominent features of these references are the converter and the treatment in the converter. The latter is "refining or Bessemerizing," so that when the claim speaks of "further treatment," it at least means "refining," and hence there is no ground for appellant's assertion that the disclaimer "added to the 2d claim an extra step not previously included in the process covered by said claim—to wit, the step of refining or Bessemerizing the mixed metal."

The case is very different from *Grant vs. Walter*, 148 U. S., 547; *Albany Steam Trap vs. Worthington*, 75 Fed. 969, and *Hailes vs. Albany Stove Co.*, 123 U. S., 582, and other cases cited in the Court of Appeals by the defendant, in which attempts were made to reissue patents by means of disclaimers. In *Grant vs. Walter*, 148 U. S., 547, it was attempted by a disclaimer to save an invalid patent by changing it from a patent for an *article of manufacture*—a peculiarly laced skein—to a patent for a process or mode of using such skein. The Court said:

"The Court below properly held that the disclaimer did not give any increased validity to the patent for the skein, or change it to one for a process, and the simple question presented is whether Grant's skein possesses features of patentable novelty over the earlier skeins shown by the testimony."

So in *Albany Steam Trap Co. vs. Worthington*, 79 F. R. 966, a disclaimer was held to be void which changed the claim from a claim for a specified construction of trap which the defendant did not use, to a claim for *any* kind of trap broadly, in combination with the return steam pipe. Defendant did not infringe prior to the disclaimer. He would have infringed if the disclaimer had been sustained.

These cases do not apply to the case at bar. The matter which remains in the specification of the Jones patent sets forth in complete and exact terms the invention stated in the second claim. The disclaimer cut out the method of mixing in a charging-ladle and the making of pig iron from mixed metal, but it left unchanged the process of the second claim, whereby the full benefit of using the direct metal was obtained. It is submitted that the records of the Courts contain few instances of more legitimate and fairer use of disclaimer than the present case presents.

SUMMARY.

For convenience we will review briefly some of the points stated in the foregoing argument.

Jones made more than a mere change in a mode of operation; his method of mixing has affected an important and radical improvement in the art of making steel. Its merit entitles it to favorable consideration.

Many discussions of metallurgical societies and some patents were published during the period of research, in which statements were made treating the problem as a simple one and suggesting remedies, but the same published reports show that when these remedies were tried they failed, as did all others, so that practically nothing was done to reach the desired end until Jones did it.

Some of the operations which were in common use in steel manufacture and in foundry practice are said by the defendant's witnesses to bear an analogy to the Jones process, but the fact is that although those operations were in everyday use in the manufacture of Bessemer steel from the date of Bessemer's invention in 1857, and for a longer period in foundry practice, and although the benefit to be derived from the use of direct metal was well known, they were never applied to the treatment of direct metal, and never suggested to any one in the business of making Bessemer steel or to any of the numerous investigators who were seeking to solve this problem, the simple and effective process of Jones. They did not suggest it, even though many of the steel works had foundries, as in the case of the Lackawanna Company, where the so-called analogous operation was in daily use. The presumption is that the Jones invention was neither a double use nor obvious. It is no answer to this to say that the analogy is now obvious to the defendant. Anything is obvious after somebody has done it.

The principle of Jones' invention is lacking in the alleged anticipations.

The irrelevancy of the plans described in the prior publications and patents can be tested by comparing them with the essential principle of the method of the patent in suit.

The discovery which underlies the Jones invention is that, the use of direct metal becomes feasible and useful if it be so treated as to render the changes in the character (composition and temperature) of the metal very gradual and to link each converter charge in character to the charge preceding it; so that, although the extreme links of the chain of charges may be widely divergent, no one charge will vary greatly from its neighbor. Each charge or heat is thus made to serve as an index for the next, and the blower can foretell the mode of working of each heat so closely that, by proper scrapping or other treatment, its working may be controlled, and the ingots cast from all the heats rendered substantially homogeneous.

The silicon content of pig metal does not necessarily determine the content of silicon in the steel ingot which is made from it ; high silicon metal within practical limits may yield an ingot as low in silicon as if it were made from a low silicon metal, for the silicon is substantially burned out in the converter.

The thing which Jones did was to employ such method of mixing as to render gradual the fluctuations of chemical composition and temperature of the successive charges of the pig metal for conversion, and thus enable the operation of the converter to be controlled, and ingots of constant physical as well as chemical character to be secured.

By his method of rendering gradual the fluctuations of the molten pig metal, Jones produced from a raw material of variable chemical composition and temperature an ingot of constant character, and this without requiring the use of any cupolas or other remelting furnaces.

As contrasted with this, the principle of the Bessemer cupola practice was to render each converter charge of constant or absolute character without any necessary relation to the other charges, each charge being independently conformed to a certain absolute standard of quality. There was no thought of linking the charges together by permitting the occurrence of fluctuations, and so controlling the fluctuations as to render them gradual.

The conceptions of Holley, Durfee and Deighton never went beyond an attempt, by an inadequate method, to reproduce the principles of cupola practice.

A graphic comparison of the conditions into which the pig metal is brought by these several processes would illustrate the direct process by a line with abrupt and violent jogs or angles ; the cupola practice by a long and practically straight line ; the plans of Durfee, Deighton and Holley, so far as we can understand them, by a series of lines at abrupt and uncertain angles to each other, each line representing a batch or group of heated mixed or standardized charges ; and the method of Jones by a line of gradual and approximately regular curvature.

And this principal is abundantly set forth in the patent in suit, which states, not that the converted charges are homogeneous relatively to each other, but that, from converter charges which are "substantially uniform," or "as uniform as possible," but which fluctuate gradually, the inventor produces a *homogeneous product* (p. 872, para. 2.). By producing a substantial uniformity of each charge of molten metal with the charge which precedes it, Jones obtains identity or homogeneity of product.

These considerations which pertain in practice to the method of the patent in suit, and which, in the eyes of the practical steel-maker constitute its distinguished characteristic, put the Jones invention upon a plane quite different from that occupied by processes of founding and cupola working, and different, also, from that occupied by the suggestions of Durfee and Holley, in which the principle of Jones' invention is lacking. In *Consolidated Valve Co. vs. Crosby*, 113 U. S., 157, 171, the Court said :

> "The prior structures never effected the kind of result effected by Richardson's apparatus, because they lacked the thing which gave success. * * * Taught by Richardson and by the use of his apparatus, it is not difficult for skilled mechanics to take the prior structures and so arrange and use them as to produce more or less of the beneficial results first made known by Richardson ; but prior to 1866, though these old patents were accessible, no valve was made producing any such results. * * * (p. 179). Richardson's invention brought to success what prior inventors had essayed and partly accomplished. He used some things which had been used before, *but he added just that which was necessary to make the whole a practically valuable and economical apparatus.*"

. The Opinion of the Circuit Court of Appeals.

In reaching the conclusion that the defendant does not infringe the patent in suit, the Court of Appeals has adopted certain reasoning, based, as we think, upon mistaken premises, which we will briefly point out :—

1. The finding of the Court, on p. 1118, para. 1, that the term "molten metal" in the claims of the patent in suit is broad enough to cover metal which has been melted in cupolas, is irrelevant if we are correct in saying that prior to Jones' invention his method has never been practiced either with cupola metal or blast furnace metal. Not only would the Jones method be of no use in preparing cupola metal for the converters (Forsyth, p. 281, x-q. 88), but it never had been used for that purpose prior to Jones' invention.

2. The ruling of the Court in the same paragraph that the object of the Jones invention cannot be limited to preparation of metal for the Bessemer process, but that it includes "a puddling furnace, an open hearth, or any other treatment to which molten metal is adapted in the *art*," by which we understand *the steel-making art*, is in like manner irrelevant unless it be shown—which is not the case—that the same method was in fact used in puddling furnaces or open hearth furnaces prior to Jones' invention. The process would be of little use and never has been used for these purposes.

3. The purpose of the disclaimer has been misunderstood. It was filed in order to eliminate certain parts of the specification which were the subject of criticism by the defendants, and which were alleged by them to have the effect of broadening the scope of the second claim. See the petition cited on p. 110 of this brief.

4. The record of the Jones application in the Patent Office does not have the effect ascribed to it by the Court of Appeals, who state that Jones has transformed his specification from a method of storing to a method of "mixing"; and the Court say (p. 1120): "Quite a transformation has taken place The storage and reservoiring features have been eliminated, the mixing has become predominant."

In this, we submit, there was error.

Reference to the specification as originally filed in the Patent Office shows (middle p. 722, and bottom of p. 723) that it contained the same statements as to the functions of the mixer in making the fluctuations of the metal gradual, as are contained in the specification of the patent as granted. It contained only one claim, and that was substantially the same as the second claim of the patent, except that it did not contain the words "preparatory to further treatment."

The original claim read as follows (p. 725):—

> "The process hereinbefore described which consists in storing charges of molten metal in a covered receptacle provided with a heat-retaining lining, removing portions only of the molten contents of the said receptacle without entirely draining or emptying the same, and successively replenishing the receptacle with fresh additions of molten metal, whereby the character of the metal so treated is equalized; substantially as described."

The method of the second claim has therefore been prominent in the specification from the first. It was the only claim which the inventor tried originally to patent.

Nor did the omission in the patent of the word "storing" which was used in the original claim have the effect of changing the scope of the invention. The process which Capt. Jones practiced and described was the same as that which the complainant uses now. He put or stored the ununiform charges of metal in the mixer and let it stay as a pool, drawing out portions from time to time. To describe this he used the appropriate word "storing." The *word* was changed in the Patent Office, but the *thought* and the *thing* which were described remain the same.

The invention of the second claim was also made prominent in the arguments filed by the inventor's attorneys. On p. 727 they speak of the invention as a "continual pouring into and drawing out of a common receptacle" which "produced such a mixing of the charges," and although they then spoke of the process as applicable either to metal "treated in the converters or used for casting *without such treatment*," the subsequent limitation of the claim in suit to the preparation of metal "*for further treatment*," *shows of itself that "further treatment" means treatment in converters*, *and that*, *as patented, the invention is not designed for any purpose of casting in foundries.*

There is nothing in all this which should prejudice the rights of the complainant. It only serves to confirm what we believe is the proper construction of the patent, and is in literal conformity to the language of the second claim.

5. On p. 1121 the Court of Appeals criticises the specification for vagueness in that it states only that the quantity which shall remain in the receptacle is to be a "*considerable quantity*." But we submit that no more appropriate term could have been chosen to indicate that a substantial pool of metal—large enough to be useful for the purpose intended—is to be left in the receptacle. A steelmaker familiar with the needs of the art would know at once what was meant, and in following the specification would do just what is done now by the parties to this suit, and by others who use the mixing process of Captain Jones.

6. On the question of infringement, our position is that the defendant in its manufacture of steel has infringed by doing what is recited in the second claim, *i. e.*, by "introducing into a mixing receptacle successive portions of molten metal, un-uniform in their non-metallic constituents (sulphur, silicon, etc.,) removing portions only of the composite molten contents of the receptacle without entirely draining or emptying the same, and successively replenishing the receptacle with fresh un-uniform additions;" and that it has obtained the benefits of regularity of working and homogeneity of product which necessarily follow the performance of those steps.

In conclusion it appears to us that much of the evidence and exhibits introduced by the defendant have no relevancy to the issues of the case.

That the invention is of value is proved by the fact that the defendent uses it, independently of the abundant testimony to the change which its introduction has made in the practice of the Bessemer process of steel manufacture. It has rendered possible for the first time the successful use of the "direct process," and enables it to produce uniform steel ingots, free from impurities imparted by contact with the fuel of cupolas.

As to the question of anticipation, it must be remembered that, to defeat the patent, each one of the steps, as well as the essential principle and purpose of the invention, must be found as a whole in some one of the alleged preceding patents, publications or alleged instances of prior public use.

A mere statement of the claim in controversy in this case will afford a complete answer.

(a) In the art of mixing molten metal to secure uniformity of the same in its constituent parts *preparatory to further treatment;*

(b) The process of introducing into a mixing receptacle *successive portions of molten metal ununiform in their metallic constituents,*

(c) Removing *portions only* of the composite molten contents of the receptacle;

(d) Without entirely emptying or draining the same;

(e) And *successively replenishing* (filling up) the receptacle with fresh ununiform additions;

Substantially as and for the purposes described.

To this test must all of the alleged anticipations be brought. None of them is able successfully to meet this test. None of them can comply with the conditions of the claim. None of them disclosed a process capable of performing the functions of the invention in controversy.

We submit to the Court that the patent in suit is a valid patent; that the defendant has infringed, and that the decree of the Circuit Court of Appeals should be reversed.

Respectfully submitted,

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